Measurement of The Best Method Between Certainty Factor And Bayes Theorem Methods in Expert System by Using SPSS and ODM Applications

(Case Study: ASD under 5 years old)

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GRADUATE PROGRAM

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THESIS

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ABSTRACT

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"Measurement of The Best Method Between Certainty Factor and Bayes Theorem Methods in Expert System by Using SPSS and ODM Applications (Case Study: ASD under 5 years old)"

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The science that study how to make a computer can act and have the intelligence of a human being is called artificial intelligence. One field of artificial intelligence is expert systems. Expert system must be able to work in uncertainty. A number of theories have been found to resolve uncertainties, including the classical probability, the probability of Bayes, Hartley theory based on classical sets, Shannon theory based on probability, DempsterShafer theory, Zadeh's fuzzy theory, and certainty factor. Many researchers use these methods in making expert system in a particular domain. In detecting a disease in an expert system, the results of data accuracy is a critical component for the achievement of the expected solution. Two studies explain the differences in the results of the accuracy of the Certainty Factor and Bayes method, although using the same domain that chronic kidney disease.

This study aims to use the method of Certainty Factor (CF) and Bayes Theorem in representing the calculation results of ASD in children under 5 years old, compare the final value result of the Certainty Factor and Bayes Theorem Method, determine the best method between certainty factor and bayes theorem that has the best accuracy in detecting the possibility of children affected by autism spectrum disorders, with the application of SPSS and ODM.

The final accuracy show 66.67% states that the final accuracy value use certainty Factor and Bayes method is as good on SPSS application, and 33.33% states that Certainty Factor which is the best method on ODM application.

CURRICULUM VITAE

Windy Dwiparaswati, was born in Bekasi on March 27th, 1992. The educational background started from SD Cendrawasih Jaya, Bekasi Elementsary School from 1998 until 2004. She continued his education to SMPN 01 Bekasi Junior High School and graduated in 2007. On 2007, she was accepted in SMA PGRI 01 Bekasi Senior High school and graduated in 2010. After graduated from senior high school, she continued to Gundarma University majoring in Information System. In 2011, she got Sarmag (Sarjana Magister) Scholarship Program from Gunadarma University majoring in Information System and finished the Undergraduate Degree on 2014. At present, she is taking the magister program majoring in Information System Management.

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However, Author still looking forward to get some criticism and suggestion from anyone to make this work better in the future. Hopefully, this work can bring some advantages to readers.

Jakarta, 26 February 2015

Windy Dwiparaswati,S.Kom

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CHAPTER I

INTRODUCTION

1.1 Background

The role of parents in children's development is to consider developments in children. According to therapist on "Klinik Smart Tumbuh Kembang Anak", Intan Rahmatin, that children’s development can already be seen since they were born with their attention to motoric activity, visual contact, and communication. Parents can find out the development of normal or abnormal. Abnormality is the difference normal behavior in children generally, such as Autism Spectrum Disorder (ASD).

Autism is a developmental disorder of brain function that includes the social, verbal communication (language) and non-verbal, imagination, flexibility, area of interest, cognition and attention. This is a disorder characterized by delayed development or abnormal social relationships and language [1].

Many factors make parents are negligent in observing the child’s development so many parents are late to realize that the child is experiencing autism. Based survey of research on the treatment center "A-Plus" Dharma Wanita PUNM, Malang, that 90% of parents at first did not know the autism spectrum, until their children are diagnosed with autism spectrum [4]. Then some of the parents, especially the mother, took the decision to carry out activities outside the home to work [4]. In addition, that 35% of parents participate less in improving knowledge and involvement in the care of children with consultation [4].

Computers were originally only used to perform data processing, today have developed its function to help people in decision-making in order for the computer to have the ability as human beings. The science that study how to make a computer can act and have the intelligence of a human being is called artificial intelligence. One field of artificial intelligence is expert systems [23].

An expert system is a branch of artificial intelligence that uses knowledge/special knowledge to solve a problem at the level of a human expert [12]. In expert systems, where the knowledge of an expert or experts in certain fields outlined in the computer program, so hopefully this program is identical like a real expert.

However, there are several approaches that can be used in building expert systems. One approach that is appropriate for the case of diagnosis of the disease is to use reasoning with uncertainty [6]. Expert system must be able to work in uncertainty. A number of theories have been found to resolve uncertainties, including the classical probability, Bayesian probability, Hartley theory based on classical sets, Shannon theory based on probability, Dempster Shafer theory, Zadeh's fuzzy theory, and certainty factor [12].

Based on these approaches, many researchers use these methods in making expert system in a particular domain. In detecting a disease in an expert system, the results of data accuracy is a critical component for the achievement of the expected solution.

Previous research are examined by the journal by Sri Rahayu, entitled "Expert System to Diagnose Diseases Kidney Failure using Bayes Method" and explained that bayes method in detecting chronic kidney disease have 63.922% accuracy results [7]. And the journal by Firdaus., Et al, entitled "Expert System for Diagnosis of Kidney Disease with Combination Methods and Methods Certainty Factor Forward Chaining" and explained that the method of Certainty Factor in detecting chronic kidney disease have 90% accuracy results [8].

Both of these studies explain the differences in the results of the accuracy of the Certainty Factor and Bayes method, although using the same domain that chronic kidney disease.

Each of these methods has a different calculation process, but have the same goal of providing the results of the accuracy of a hypothesis. The results of both methods can be analyzed and compared, so as to determine better methods for use in detecting autism spectrum disorders in children under 5 years old in this case.

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1.2 Scope of The Research

Problems discussed in this research are:

1. Measure of Believe value for certainty factor method derived from an expert, and the calculation of the probabilities in Bayes Theorem method based on the medical records at the "Klinik Smart", the number of data is 40 children. Children under 5 years old, with the four age criteria, there are 0-1 year old, 1 more - 2 years old, 2 more - 3 years old and 3 more - 5 years old.
2. The result of certainty factor and Bayes Theorem method based on symptoms data on medical records. Data are compared is the same data of age criteria, symptoms inputted, and disorder outputted, for diagnosing ASD.
3. Data are compared using SPSS application is data from the final value calculation certainty factor and Bayes Theorem method, by testing tcount on output results in SPSS application. If the result is H1 is accepted, data are compared using ODM application.

1.3 Aim of The Research

As for the aim of this study is as follows:

1. Using the method of Certainty Factor (CF) and Bayes Theorem in representing the calculation results of ASD in children under 5 years old.
2. Comparing the final value result of the Certainty Factor and Bayes Theorem Method.
3. Determining the best method between certainty factor and Bayes Theorem that has the best accuracy in detecting the possibility of children affected by autism spectrum disorders, with the application of SPSS and ODM.

1.4 Benefit of The Research

Benefits that can be obtained from objective of this thesis are:

1. For the researchers, is expected to be a guide or reference for research in the field of information systems in the future.
2. For other researchers, is expected to be one of the sources of literature for similar research activities.
3. For the physician or health authorities, is expected to become a tool in diagnosing the disease.

CHAPTER II

LITERATURE REVIEW

2.1 Source of Research Data

The data source is anything that can provide information about the data. Based on the source, the data can be divided into two, namely the primary data and secondary data.

2.1.1 Primary Data

Primary data is data that is created by the researcher for a specific purpose to solve the problems that are being handled. The data collected by the researchers directly from the first source or object where research is conducted [15].

2.1.2 Secondary Data

Secondary data is data that has been collected for purposes other than solve the problem at hand. This data can be found quickly. In this study, the secondary data source is literature, articles, journals and websites on the internet with regard to the research conducted [15].

2.2 Data Collection Method

The method is generally defined as a process, method, or procedures used to solve a problem. The methods used to collect the data in this study are as follows:

2.2.1 Literature

Literature is the first step in the method of data collection. Literature study is a method of data collection is directed to the search of data and information through documents, whether written documents, photographs, images, and electronic documents that can support the writing process. "The results will also be more credible if supported by photographs or academic papers and art that have been there."[14]. Literature study is then it can be said that literature can affect the credibility of the results of research conducted.

2.2.2 Observation

Observation is the second step in data collection after the authors to study literature. Observation is the technique of data collection by observation of existing conditions in the field. By observation, the authors become better informed on the subject and the object being studied [14].

2.2.3 Interview

The interview was taken the next step after the observation is made. Interview or interviews are data collection techniques by way of face to face directly between interviewer with informants. Interviews conducted if the data obtained through observation of less depth. This is in accordance with the proposed [14] that "the interview was used as data collection techniques if researchers want to know the things of informants more depth."

2.3 Artificial Intelligence

Artificial Intelligence (AI) is an area in computer science. The term encompasses many definitions, but more experts agree that AI is concerned with two basic ideas. First, it involves studying thought processes of human (to understand what intelligence is); second, it deals with representing and duplicating these processes via machine (e.g., computers and robots) [26].

There are several definitions of artificial intelligence (Artificial Intelligence), among others:

1. Artificial Intelligence is one part of computer science that makes that machine (computer) and can do the job as good as done by humans [9].
2. Artificial Intelligence is part of the computer so it should be based on Theoretical Sound (Sound Theory) and principles of art. This principle includes the data structures used in knowledge representation, the algorithm needed to apply that knowledge, as well as programming languages and techniques used in implementing it [11].

The purpose of artificial intelligence by [26]:

1. Making machines become more intelligent (objective)
2. Understanding what is intelligence (scientific purposes)
3. Making machines more useful (entrepreneurial purposes)

2.4 Expert System

Expert system is seeking to adopt a system of human knowledge into a computer so that the computer can solve the problem as it is commonly done by experts. In this expert system, the lay people can solve quite complicated problems that are actually only be solved with the help of experts. The expert system will also help its activity as highly experienced assistant [9].

There are several definitions of expert systems, among others[9]:

a. According to Dunkin: an expert system is a computer program designed to model the problem solving capabilities carried out by an expert.
b. According Ignizio: an expert system is a expert system model and related proseur, in a particular domain, where the level of expertise that can be compared with the skill of a specialist.

c. According Giorrantaro and Riley: an expert system is a computer system that can match or mimic the ability of an expert.

2.4.1 Users of Expert System

Expert system can be used by:

a. Lay people who are not experts to improve their ability to solve problems.
b. Knowledgeable expert as an assistant.

An expert system is a program that can replace the presence of an expert. An expert system is developed to be able to provide expertise at all times and in various locations, automatically doing routine tasks requiring an expert, an expert who will retire or leave, present the services of an expert is expensive, and the expertise need also on the environment hostile [10].

2.4.2 Characteristics of Expert System

Expert system has characteristics that are limited to specific sectors, can provide reasoning for data that is incomplete or uncertain, it can be argued that it provides a series of reasons circuitry understandable manner, based on a certain rule, designed to be developed in steps, the output is the advice or recommendation, the output depends on the dialogue with the user, and the knowledge base and the inference engine apart [10].

2.4.3 Advantages

The advantages of using expert system are [10]:

a. Create a layman can work like an expert.
b. Work with information that is incomplete or uncertain.
c. Increase output and productivity.
d. Improve the quality.

e. Provide advice that is consistent and can reduce the error rate.
f. Create more complex equipment is easy to operate because the expert system can train inexperienced worker.
g. Reliable.
h. It can not be tired or bored, and consistent in giving an answer.
i. Have the ability to solve complex problems.
j. Allow the transfer of knowledge to a remote location as well as extending the reach of an expert, can be obtained and used anywhere.

2.4.4 Knowledge Base

The knowledge base contain knowledges in problem solving, certainly in the particular domain. There are two forms of knowledge base approach are very commonly used, namely [9]:

1. Rule-based reasoning (Rule-Based Reasoning). In the rule-based reasoning, using the knowledge presented in the form of rules: IF-THEN. This form is used when we have a number of expert knowledge on a particular issue, and an expert can solve the problem sequentially. Besides, it also used where necessary explanations about the trail achievement solutions.
2. Case-based reasoning (Case-Based Reasoning). In case-based reasoning, knowledge base will contain solutions that have been achieved previously, then lowered a solution to the current situation (the facts). This form will be used if the user wants to know more on the cases are almost the same. In addition, this form is also used when we have had a number of situations or specific cases in the knowledge base.

2.5 Autism

Autism is derived from the Greek word " autos " meaning self. The word is used in the field of autism psikatri to describe symptoms [1].

Autism is a disorder that begins and experienced in childhood. Infantile autism (autism in childhood) is a disorder of the inability to interact with others, interference with the mastery of language indicated that delayed echolalia (mimic/parrot), mutism (silence, do not have the ability to speak), the reversal of the sentence word (your use to me), the presence of repetitive activities and stereotyped play, these memories are strong, and the obsessive desire to maintain regularity in the environment, fear of change, poor eye contact, more like images and inanimate objects [2] .

Autism is a developmental disorder occurring in the future — especially children — who can not afford to make a social interaction and as if living in a world of their own [5].

2.5.1 Classification of Autism

Classification of moderate and severe autism often concluded after a child is diagnosed with autism. This classification can be provided through Childhood Autism Ratting Scale (CARS) [19].

There are three autism spectrum disorder in children, they are [5]:

A. Autistic Disorder

Childhood autism is a developmental disorder in children whose symptoms have appeared before they reache the age of three years. If parents already know the criteria for autistic children from an early age, the symptoms of children with autism premises can be easily detected [5].

Bruer explained that language skills can continue obtained on age after childhood. Exception of those in the early days did not ever hear people talking [5].

B. Asperger's Syndrome

As in autism, Asperger syndrome, also has disruption in communication, social interaction, and behavior, but it's not as severe as in autism [5].

Most of these children are not impaired speech development, speech on time, and quite smoothly although there is also a speech rather late. However, even though they know how to speak, they are less able to communicate reciprocally. Communication is only running in the same direction [5].

C. PDD-NOS

PDD - NOS commonly referred to as autism that are not public. PDD-NOS also show symptoms of impaired development in communication, interaction, and behavior. However, the symptoms are not as much as in autism. The quality of the disorder is lighter, so the kids can still do eye contact, facial expressions are not too flat, and still be able to communicate [5].

Practitioners are likely to require competence in using a wide range of ABA-based procedures to address the communication needs of children with Autism Spectrum Disorder (ASD) [24]. The need for wide-ranging competence stems from two related facts: First, ASD is not a homogenous condition, but rather covers three more specific conditions: (a) Autistic Disorder, (b) Asperger syndrome, and (c) Pervasive Developmental Disorder Not Otherwise Specified (PDD-NOS). While each of these conditions is associated with communication impairment, the nature and severity of impairment differs in certain general ways across these three diagnostic categories. Specifically, communication impairment is comparatively subtle in Asperger syndrome and PDD-NOS (e.g., lack of conversational turn-taking), but more obvious and pronounced in Autistic Disorder. Second, even within each of these three categories, individual children will present with varying degrees of speech development and communication impairment [24].

Many children with a diagnosis of Autistic Disorder –perhaps up to 50% – are essentially mute, for example, while others may acquire speech that appears nonfunctional and largely echolalia [25]. Table 2.1 provides a summary of the general nature of communication impairment associated with Autistic Disorder, Asperger syndrome, and PDD-NOS [20].

Table 2.1 Overview of communication deficits and excesses associated with ASD [20]

Disorder	Description of communication deficits and excess
Autistic disorder	Speech is substantially delayed and about 50% of children fail to acquire speech. Those that acquire speech often have fluency problems and use it in a nonfunctional, stereotyped, or ritualistic manner. The child may simply repeat others (echolalia) or perseverate on words or phrases. Spontaneous communication is often lacking. Communicative attempts are mainly for instrumental (e.g., requesting), rather than social (e.g., conversational) purposes. The child may fail to respond to other's speech indicating significant deficits in receptive language.
Asperger syndrome	Speech is not obviously delayed, but social deficits are apparent during communicative interactions. The child may pursue preferred topics of conversation in detail and shows deficits in many of the paralinguistic aspects of communication, such as personal space, use of facial expression and gestures to convey meaning, and grammatical intonation. The child may have considerable difficulty in conversational exchanges, such as knowing when and how to terminate conversations appropriately.
PDD-NOS	Communication impairments are similar to but less severe than in Asperger syndrome. Conversations often focus on a limited range of idiosyncratic topics. The child may not seem to enjoy conversation with others and may appear anxious and awkward when engaged in social communication.

2.5.2 Characteristics of Autism

Children with autism have characteristics in the field of communication, social interaction, sensory, play pattern, behavior and emotion [3].

A. Communication

There are several symptoms in communication, they are [3]:

1. Language development is slow or none at all.
2. Look like a deaf child, trouble speaking, or never speak but later vanished.
3. Sometimes the words used are not appropriate means.
4. Babbling meaningless repetitive language incomprehensible to others.
5. Talk is not used for communication devices.
6. Glad to mimic or parrot (echolalia).
7. They like to mimic something, they can memorize well all singing words without understanding the meaning.
8. Most of these children do not speak (non-verbal) or a little talk (less verbal) until adulthood.
9. Like to hug at the hands of others to do what he wants, for example if they want to ask something.

B. Social Interaction

There are several symptoms in social interaction, they are [3]:

1. People with autism prefer to be alone.
2. Little or do not have eye contact or avoid eye contact.
3. Not interested in playing with friends.
4. When asked to play, he does not want to and get away.

C. Sensory

There are several symptoms in sensory, they are [3]:

1. Very sensitive to touch, like do not like to be hugged.
2. When you hear the sound of monkeys immediately closed ears.
3. Happy kiss-kiss, lick toys or objects.
4. Not sensitive to pain and fear.

D. Play Pattern

There are several symptoms in play pattern, they are [3]:

1. Do not play like children in general.
2. Do not like to play with his peers.
3. Uncreative, unimaginative.
4. Do not play by the function of toys, such as bicycles behind the wheel twisted around.
5. Glad to rotate objects such as a fan, a bicycle wheel.
6. Can be very attached to certain objects that are held on and taken anywhere.

E. Behavior

There are several symptoms in behavior, they are [3]:

1. Can behave hyperactive or deficit.
2. Show the simulated behavior such as rocking self, and perform repetitive motions.
3. Do not like the changes.
4. Can also sit staring blankly.

F. Emotions

There are several symptoms in emotion, they are [3]:

1. Often angry for no apparent reason, laughing, crying for no reason.
2. Raging out of control if not prohibited granted his wish.
3. Sometimes likes to attack and destroy.
4. Sometimes children behave hurting himself.
5. Not having empathy and do not understand other people's feelings.

However, these symptoms do not have to be on every child with autism. Children with severe autism may exist but almost all of the symptoms on the mild group there may be only partially [3].

2.6 Certainty Factor Method

Certainty factor was introduced by Shortliffe Buchanan in the manufacture of MYCIN. Certainty factor (CF) is a clinical parameter values given MYCIN to show how much confidence [12].

The basic formula of certainty factors [12]:

$$\mathbf{CF(H,E) = MB(H,E) - MD(H,E)} \quad (1)$$

Description:

CF (H, E)	: certainty factor of a hypothesis H which is influenced by symptoms (evidence) E. CF value ranging from -1 to with 1. A value of -1 indicates an absolute distrust while the absolute value of 1 indicates belief.
MB (H, E)	: the size of the increase in confidence (measure of increase belief) against the hypothesis H is influenced by symptoms of E.
MD (H, E)	: the size of the increase distrust (measure of increase disbelief) against the hypothesis H is influenced by symptoms of E.

The basic form formula certainty factor of a rule IF E THEN H is as shown by the following equation 2:

$$\mathbf{CF(H,e) = CF(E,e) * CF(H,E)} \quad (2)$$

Description:

CF (E, E)	: certainty factor is influenced by the evidence E
CF (H, E)	: certainty factor hypothesis assuming evidence known with certainty, when the CF (E, e) = 1.
CF (H, E)	: certainty factor hypothesis is influenced by evidence e.

In the implementation of the disease diagnosis expert system will use the formula:

$$\mathbf{CF(R1,R2) = CF(R1) + CF(R2) – [(CF(R1)\ x\ CF(R2)]}$$

For a given value of CF is positive. The formula can then be applied to several different rules are stratified. CF value of each premise / symptom is the value given by an expert or literature that support.

A. Advantages of Certainty Factor Method

The advantages of using the certainty factor, are [10]:

a. This method is suitable for the usage in an expert system to measure whether something sure or not sure to diagnose the disease as an sample.

b. Calculation using this method in a single count two data processing can only be so accurate data can be maintained.

B. Disadvantages of Certainty Factor Method

The disadvantages of using the certainty factor, are [10]:

a) The general idea of modeling human uncertainty by using numerical methods certainty factor is usually debated. Some people would dispute the notion that the formula for the certainty factor above method has some truth.

b) This method can only process two uncertainty / certainty data. Needs to be done several times data processing for more than two pieces data.

c) CF values given are subjective because every expert assessment may vary depending on the knowledge and experience of experts.

2.7 Bayes Theorem Method

Bayes theorem is adopted from the name of the inventor Thomas Bayes around 1950. Bayes Theorem is a probability theory that takes into account the condition of the probability of an event (hypothesis) depend on other events (evidence). Basically, the theorem says that an event occurring in the future or that has not occurred can be predicted with the requisite previous events that have occurred [16].

The probability itself can be defined as a quantitative measure of the uncertainty of information or events. The probability of having an index value ranging from 0 to 1. It is also influenced by the total number of events during the experiment. If the probability of an event is 0 (zero), then the situation can be assured definitely will not happen. However, if the probability of an event is 1 (one), then the situation can be assured inevitable. Meanwhile, suppose an event has a probability of 0.5, then the event has doubts that the maximum level [17].

In the Bayes theorem is often called the term conditional probability. Conditional probability is an event that may or may not depend on the occurrence of other events. This dependence can be written in the form of conditional probability as follows: P (A | B), means that the probability that event A will occur when the incident occurred or B can be referred to as the joint probability of events A and B [17].

Bayes Theorem is a method used to deal with the uncertainty of the data and perform analysis in the decision making the best of a number of alternatives with the aim of producing optimal acquisition. Bayes theorem provides several formulas to draw conclusions based on the facts (evidence) and hypothesis [16].

a. Bayes Theorem evidence shape for single and single hypothesis

$$P(H \mid E) = \frac{P(E \mid H).P(H)}{P(E)} \qquad (2.1)$$

Specification:

P (H | E) = the probability of the hypothesis H happen if evidence E occurs

P (E | H) = the probability of evidence E, if the hypothesis H occur

P (H) = the probability of the hypothesis H regardless of any evidence

P (E) = probability evidence E regardless of any

b. Bayes Theorem evidence shape for single and double hypothesis

$$P(H_i \mid E) = \frac{P(E \mid H_i).P(H_i)}{\sum_{k=1}^{m} P(E \mid H_k).P(H_k)} \quad (2.2)$$

Specification:

P (Hi | E) = the probability of the hypothesis Hi happen if evidence E occur

P (E | Hi) = probability of evidence E, if the hypothesis Hi occur

P (Hi) = probability of the hypothesis Hi regardless of any evidence

m = number of hypotheses that occur

c. Bayes Theorem evidence shape to double and double hypothesis

$$P(H_i \mid E_1E_2...E_n) = \frac{P(E_1E_2...E_n \mid H_i).P(H_i)}{\sum_{k=1}^{m} P(E_1E_2...E_n \mid H_k).P(H_k)} \quad (2.3)$$

Bayes Theorem is used in the decision-making process can't be separated from probability theory as the basic concept. Bayes theorem known as the basic formula for conditional probability that is not free.

Bayesian probability theory is a branch of mathematical statistics theory that allows us to create a model of the uncertainty of an event occurring by combining a general knowledge of the fact of observation [18].

2.8 SPSS

SPSS is a shortening of the Statistical Program for Social Science is a computer application program package for analyzing statistical data. SPSS can use almost all types of data files and use them to create reports in the form of tabulation, chart (graph), plot (diagram) of the various distributions, descriptive statistics, and complex statistical analysis.

So it can be said SPSS is a complete system, a comprehensive, integrated, and very flexible for statistical analysis and data management, so that continuation of SPSS was experiencing growth, which at the beginning of the release is the Statistical Package for the Social Science, but in its development turns into Statistical Product and Service Solution [22].

2.8.1 Paired Sample T Test Procedure

Procedure paired sample t test was used to test two samples in pairs, whether having an average which are significantly different or not. To perform this procedure from SPSS main menu, choose **Analyze → Compare Mean → Paired-Samples T Test.** It will display a dialog box Paired Sample T-test.

All numeric variables in your data file will be displayed in the list box variable [22].

1. Move one or several pairs of variables at once to the box Paired Variables.

   To move the perform pair the following steps:

   a. Click on one of the variables, so it will be displayed as the first variable in the Current Selections box.
   b. Click the other variables, as a partner, so it will be displayed as a second variable in the Current Selections box.
2. To create a pair of variables again. Repeat steps above.
3. Click the options to determine the value of confidence of 95%.
4. Click OK to get the results of the analysis.

2.9 Open Decision Maker

The Open Decision Maker (ODM) is designed to support a user in a decision making process. For this process ODM uses the Analytic Hierarchy Process (AHP) method. This method is similar to the value benefit method, but it also compares the rating quality for all comparisons and shows the consistency of the decisions which have been made.

Use the AHP method it is also possible to rate alternatives with an inconsistency, but the inconsistency is displayed in the consistency ratio CR. The CR can be seen as the quality of the weightings. A high CR is a sign of random/very inconsistent ratings. This additional information the quality of decisions can be improved. ODM will guide the user from start to finish through the decision making process step by step with a user friendly graphical interface [21].

2.10 Past Research

In this research, be required various sources of previous research that used bayes theorem and certainty factor methods and compare the two methods. The purpose are know how the calculation of each method on the same domain but in different cases, and compare calculation two methods in the same case in a particular domain.

The first research is Comparative Analysis Naïve Bayes and Certainty Factor Method on Expert System in Diagnosing Genital Inflammatory Disease (Fisti, Martaleli, Eka, 2014), this journal explains that applications built using 2 methods, bayes naïf and certainty factor methods, in diagnosing genital inflammatory disease. And this journal explains there are 14 symptoms and 4 type diseases. Then the results of the system is tested by comparing the results of both methods with facts to 25 people. And it can be concluded that 80% percentage of validation for certainty factor method is better than bayes naïf method with 68% [13].

The second research is expert system for diagnosing kidney disease by using Bayes Method (Sri Rahayu, 2013), this journal is not described how many symptoms and kidney diseases are. However this journal provides two example of calculation on two type kidney disease, there are acute and chronic kidney, with the input of as many as 16 symptoms of both diseases. And it can be concluded that the application can issue a valid calculation results is equal to manual calculations. In the belief result of chronic kidney disease is 63.922% [7].

The third research is expert system for the diagnosis of kidney disease with a combination of certainty factor and forward chaining method (Firdaus, Sarjon, Gunadi, 2014), this journal explains there are 29 symptoms and 7 type diseases, but CF value provided by each symptom is not clear how amount of the value and calculation of the CF total value is. However, there are 7 sets of rules that are given and generate a CF total value in each type of the disease. And it can be concluded that the results of the belief system is equal to the result of the calculation by using the theory of CF. So that the accuracy of the results are in accordance with the calculation. In the belief result of chronic kidney disease is 90% [8]. In table 2.2 show specification of journal in the study above.

Table 2.2 Specification of Journals

Journal Title	Problem	Research Methodology	Result	Advantage	Disadvantage
Comparison of Naive Bayesian Analysis Methods And Certainty Factor In Diagnose Expert System In genitalia inflammatory disease.	The disease is found increasingly more kind. So, we need a health expert or a doctor who specializes specifically to deal with the disease as well. Insufficient doctors resulted in doctors burden is increasingly high. So, we need technology that can assist physicians in dealing with the problems it faces.	1.Certainty Factor Method 2.Naïve Bayes Method	Percentage validation for certainty factor method is much better than the Naive Bayesian method, the percentage of Certainty factor is 80% while the naive Bayesian is 68%.	1. Calculation results Naive Bayes done by calculating the opportunities answers from the user by any disease, according to the number of data training. 2. Conducting testing on 25 users by comparing the results of the two methods is more accurate with the actual facts.	1. Not explained how to get the CF Value 2. Not described symptoms experienced anything on the disease
Expert System for Diagnosing Renal Disease by Using Bayes Method.	Kidney disease is a serious disease that can affect anyone, when the late handled properly, acute renal failure will turn into a permanent chronic renal failure.	1. Bayes Theorem Method	The total value of Bayes method in acute renal failure at 56.7678% and total value in chronic renal failure amounted to 63. 922%	1. Calculation of the two diseases is quite clearly spelled out from the beginning to the end of the calculation 2. Generate a total of Bayes on two types of disease	1. Not explained sum of each hypothesis value at each symptom 2. Not Specified number of illnesses and symptoms in these cases
Expert System for Diagnosis of Kidney Disease with Combination Methods and Methods Certainty Factor Forward Chaining.	Patients with kidney disease do not know the type of the disease and its symptoms and overcome, it is expected that through expert system further treatment of the disease can be quickly	1. Certainty Factor Method	The total value of Bayes method in acute renal failure by 70% and total value in chronic renal failure is equal to 90%	1. Generate a total of CF on each possibility on seven types of disease 2. Indicate the number of illnesses and symptoms experienced.	1. Not explained each value of CF 2. Not explained how the CF calculation so as to produce a final value of CF

CHAPTER III

RESEARCH METHODOLOGY

3.1 Source of Research Data

The data source is anything that can provide information about the data. Based on the source, the data can be divided into two types, there are:

3.1.1 Primary Data

In this study, the primary data source is obtained directly from the knowledge and experience of a specialist autism therapist.

3.1.2 Secondary Data

In this study, the secondary data source is literature, articles, journals and websites on the internet with regard to the research conducted.

3.2 Data Collection Method

At several steps of data collection is to be able to study and resolve the issues to be discussed. The steps of the data collection:

3.2.1 Literature

At this step, the writer collected and studied the books and browsed on the internet that provide information relevant related to the children's development under five years old, and children's behavior with autism.

3.2.2 Interview

At the interview step, the writer conducted interview with the owner and therapist at the “Klinik Smart Tumbuh Kembang Anak”, in Bekasi Barat. Writer obtains the necessary data from the therapist to do calculation the methods of certainty factor and Bayes Theorem.

3.3 Research Methodology

Research is the process of studying, understanding, analyzing, and solving problems based on existing phenomena and also a series of long process and related systematically.

Good and focus research will lead to the good conclusion too, in order that the research goes well and targeted then research is needed a research methodology diagram that contains a description and steps that must be done in implementing application, ranging from early step is the knowledge base analysis until the final step is result of comparison.

Research methodology diagram can be seen in figure 3.1.

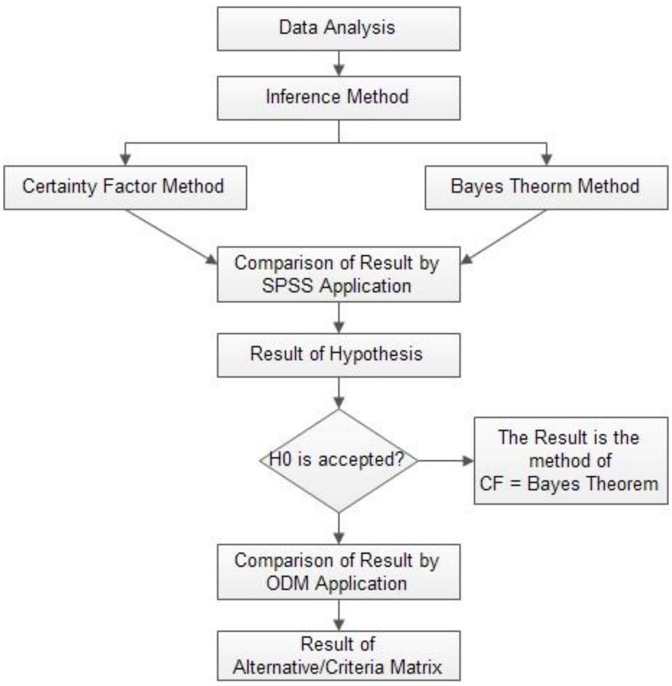


Figure 3.1 Flowchart of Research Methodology

3.3.1 Data Analysis

The data analysis step will be collected from an expert and books related. Data is needed to achieve early diagnosis differences in children's behavior that led to the Autism Spectrum Disorder, based on the age and children's development.

Here are the data collected from the interview:

3.3.1.1 Data Analysis of Age Criteria

The data analyzed is children data under 5 years old. According an expert, each age criteria has different symptoms and therefore the age criteria are divided into 4 types, as described in table 3.1. Table 3.1 shows the age criteria that have been grouped.

Table 3.1 Age criteria

	Age
U1	0 – 1 year old
U2	1 more – 2 years old
U3	2 more – 3 years old
U4	3 more – 5 years old

3.3.1.2 Data Analysis of Autism Spectrum Disorder

The classification Autism Spectrum Disorder is as follows:

Table 3.2 Autism Spectrum Disorder

	Autism Spectrum Disorder
S1	Autistic Disorder
S2	Asperger Syndrome
S3	PDD-NOS

Spectrum classification is divided by Autism Spectrum Disorder categories, they are: Autistic Disorder, Asperger Syndrome, and PDD-NOS.

3.3.1.3 Data Analysis of Symptoms

The symptoms that will be processed and be analytical inputs are some of the symptoms of 31 symptoms in Autistic disorder, Asperger syndrome, and PDD-NOS. Here is the whole classification of symptoms that found on the third spectrum.

Table 3.3 Whole Symptoms

Code	Symptoms	Code	Symptoms
G1	The child hasn't eye contact	G17	The child more often attention to his(her) hand
G2	The child has eye contact	G18	The child loves to hurt him(her)self by way of a bite or scratch
G3	The child doesn't want to interact at all with other people	G19	The child is only interested in one particular object
G4	The child still want to interact normally with other people but with certain people	G20	At the age of 1 year progress, the child is not interested in around the environment
G5	The child doesn't have a social smile (smile back to others)	G21	At the age of 1 year progress, the child is not interested in socializing with other children
G6	Babies more than 2 hours of sleep too much	G22	At the age of 1 year progress, the child never asks anything with pointing finger
G7	When the child is doing activity, the child easily distracted and difficult to return the previous activity	G23	At the age of 4 months of progress, the child does not respond, when his name called
G8	Movement of the hands and feet (simultaneously) is over, especially when too happy / not happy	G24	Happy if left himself
G9	In the progression of baby aged more than 3 months, the baby is not "Babbling" (eg: Baby say ma-ma or da-da repeatedly)	G25	The child will get angry if there is a change in the habits
G10	In the progression of baby	G26	The child often strange

	aged more than 7 months, the baby is not "Lalling" (eg: Baby say one syllable like mama or dada)		noises
G11	Do not want to play a simple game (like “cilukba”) at the age of 7 months	G27	The child can’t start a communication with others
G12	The child suddenly crying or laughing softly	G28	The child often seek attention by talking loudly and do not care if someone else wants to steer the conversation to other topics
G13	At the age of 1.5 years of progress, the child is not "echolalia" (like a parrot)	G29	The Child angry or raging frequently
G14	At the age of 1.5 years of progress, the child can’t express the desire of the words (eg: Asking the mother's milk)	G30	The child is very difficult to relate with others, but doesn't avoid social contact
G15	At the age of 1.5 years of progress, the child can’t understand commands given (eg: the child is asked to push chair)	G31	The child has a fixed routine
G16	Rigid when picked up		

3.3.1.4 Analysis of Input Data

The data used as input to the detection are symptoms. As has been mentioned in the previous section there are 31 symptoms experienced by children ASD (Autistic Spectrum Disorder), these symptoms will be processed as input to the certainty factor (CF) and Bayes Theorem method.

1. **Analysis of Input Data in CF Method**

Input data for the CF method in the form of symptoms with CF values that have given by therapist as an expert. Expert gives CF values on each symptom based on her experience and knowledge. CF value given to each symptom according to four age criteria predetermined. This value can be the same or different from value of existing symptoms at the age criteria other.

Here is the code of symptoms and range of CF values to be written data inputted in table 3.4.

Table 3.4 Code of Symptoms and Range CF Values

Code	Value	Code	Value
G1	0…1	G17	0…1
G2	0…1	G18	0…1
G3	0…1	G19	0…1
G4	0…1	G20	0…1
G5	0…1	G21	0…1
G6	0…1	G22	0…1
G7	0…1	G23	0…1
G8	0…1	G24	0…1
G9	0…1	G25	0…1
G10	0…1	G26	0…1
G11	0…1	G27	0…1
G12	0…1	G28	0…1
G13	0…1	G29	0…1
G14	0…1	G30	0…1
G15	0…1	G31	0…1
G16	0…1		

Based on Table 3.4, each symptom has a range value between 0 and 1 [12]. But according to expert, she can’t give value of 1 as the value of the confidence was definitely happening, and can’t give a value of 0 as the value of the confidence that certainly not happened. Thus, the range given by experts is 0 < CF value < 1.

2. Analysis of Input Data in Bayes Theorem Method

Input data for Bayes Theorem is two pieces probability data that obtained from medical records "Klinik Smart Tumbuh Kembang Anak". The probability data is probability with and without looking at the disease. In accordance with data, the data is also divided into four age criteria.

Here is the code of symptoms and range probability of value to be written data inputted in table 3.5.

Table 3.5 Code of Symptoms and Range Probability Value With Looking at Disease

Code	S1	S2	S3	Code	S1	S2	S3
G1	0…1	0…1	0…1	G17	0…1	0…1	0…1
G2	0…1	0…1	0…1	G18	0…1	0…1	0…1
G3	0…1	0…1	0…1	G19	0…1	0…1	0…1
G4	0…1	0…1	0…1	G20	0…1	0…1	0…1
G5	0…1	0…1	0…1	G21	0…1	0…1	0…1
G6	0…1	0…1	0…1	G22	0…1	0…1	0…1
G7	0…1	0…1	0…1	G23	0…1	0…1	0…1
G8	0…1	0…1	0…1	G24	0…1	0…1	0…1
G9	0…1	0…1	0…1	G25	0…1	0…1	0…1
G10	0…1	0…1	0…1	G26	0…1	0…1	0…1
G11	0…1	0…1	0…1	G27	0…1	0…1	0…1
G12	0…1	0…1	0…1	G28	0…1	0…1	0…1
G13	0…1	0…1	0…1	G29	0…1	0…1	0…1
G14	0…1	0…1	0…1	G30	0…1	0…1	0…1
G15	0…1	0…1	0…1	G31	0…1	0…1	0…1
G16	0…1	0…1	0…1				

Table 3.6 Code of Symptoms and Range Probability Value Without Looking at Disease

Code	Value	Code	Value
G1	0…1	G17	0…1
G2	0…1	G18	0…1
G3	0…1	G19	0…1
G4	0…1	G20	0…1
G5	0…1	G21	0…1
G6	0…1	G22	0…1
G7	0…1	G23	0…1
G8	0…1	G24	0…1
G9	0…1	G25	0…1
G10	0…1	G26	0…1
G11	0…1	G27	0…1
G12	0…1	G28	0…1

G13	0…1	G29	0…1
G14	0…1	G30	0…1
G15	0…1	G31	0…1
G16	0…1		

3.3.1.5 Analysis of Output Data

The data are used as output of detection result is also different for certainty factor and Bayes Theorem method. Here is the output data analysis for certainty factor and Bayes Theorem.

1. Analysis of Output Data in CF Method

Here are output statements from the CF method that are described in table 3.7.

Table 3.7 Output Statements from CF Method

Formula	Spectrum
CF (S1) > CF (S2) > CF (S3) Value	Autism
CF (S2) > CF (S1) > CF (S3) Value	Asperger
CF (S3) > CF (S2) > CF (S1) Value	PDD-NOS

In table 3.7 explains that the output on the CF method, if the value of CF (S1)> CF (S2)> CF (S3) then will generate an Autistic disorder, if the value of CF (S2)> CF (S1)> CF (S3) then will generate an Asperger syndrome, and if the value of CF (S3)> CF (S2)> CF (S1) then will generate a PDD-NOS.

2. Analysis of Output Data in Bayes Theorem

Here are output statements from the Bayes Theorem that are described in table 3.8.

Table 3.8 Output Statements from Bayes Theorem

Formula	Spectrum
B (S1) > B (S2) > B (S3) Value	Autism
B (S2) > B (S1) > B (S3) Value	Asperger
B (S3) > B (S2) > B (S1) Value	PDD-NOS

In table 3.7 explains that the output on the Bayes Theorem, if the value of probability B (S1) > B (S2) > B (S3) then will generate an Autistic disorder, if the value of probability B (S2) > B (S1) > B (S3) then will generate an Asperger syndrome, and if the value of probability B (S3) > B (S2) > B (S1) then will generate a PDD-NOS.

3.3.1.6 Analysis of Medical Record Data

Medical record data, which is included in the appendix, is given by experts as many as 40 children with four criteria of age. Each age criteria there were 10 children who have ASD. It can be seen in appendix 1.

For example, in the range of 0 to 1 year old, children who have autistic disorder as many as four children with different symptoms, and then 3 children have Asperger syndrome and PDD-NOS, with each different symptom.

Here is a table of medical records at the age of 0-1 year old:

Table 3.9 Medical Records at the age of 0-1 year old

	0-1 year old (U1)		
	S1	S2	S3
1	G1,G3, G5, G7, G11	-	-
2	G1, G3, G6, G8, G10	-	-
3	G1, G3, G9, G10, G11	-	-
4	G1, G3, G5, G7, G8	-	-
5	-	G2, G4, G5, G7, G9, G10, G11	-
6	-	G2, G4, G6, G8,	-

		G11	
7	-	G2, G4, G5, G7, G8, G10	-
8	-	-	G2, G3, G5, G7, G10, G11
9	-	-	G2, G3, G6, G7, G8, G11
10	-	-	G2, G3, G5, G8, G9, G10

Table 3.9 is a medical record data for ages 0 to 1 year old. For ages 1 more - 2 years old, two more - 3 years old, and 3 more 5 years old are included in the appendix 2.

This data will be used to be calculated the value of probability with and without looking at disease of Bayes Theorem, and for the calculation of the value of total confidence in CF and Bayes Theorem method based on the symptoms experienced by a patient at particular age range.

3.3.2 Inference Method

The next step is to apply the method or approach used to calculate the values of the fact that the data has been analyzed in the research. In this research, are used two methods: Certainty Factor and Bayes Theorem methods. Each method has a different way of calculation.

Here is a description from calculation of each method:

3.3.2.1 Stages of CF Method Calculation

Based on the symptoms experienced, these symptoms will be processed to the calculation of CF method. At the end of the calculation will be concluded in the form of the number of value confidence on the type ASD experienced by children. Here is a flow chart of CF Method calculation that is described in figure 3.2.

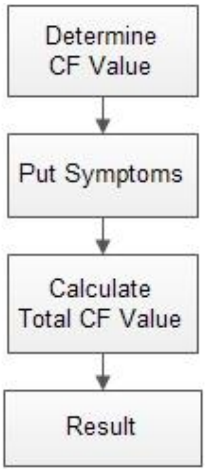


Figure 3.2 Flowchart of CF Method Calculation

Based on Figure 3.2, the process starts from determining value CF at each symptom in each age criteria, given value derived from an expert, the next is to put the symptoms experienced by children based on medical record data according to the age criteria of the children, then calculate the total value with the formula CF(R1,R2) = CF(R1) + CF(R2) – [(CF(R1) x CF(R2)], and obtain results in a total CF value in the form of a belief value of the result a disease.

3.3.2.2 Stages of Bayes Theorem Calculation

Based on medical record data, then the data is processed into Bayes Theorem calculation. At the end of the calculation will be concluded in the form of the number of value confidence on the type ASD experienced by children. Here is a flow chart of Bayes Theorem calculation that is described in figure 3.3.

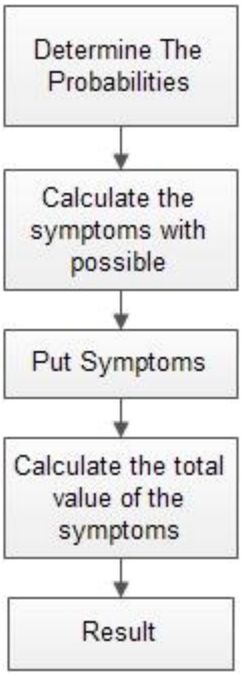


Figure 3.3 Flowchart of Bayes Theorem Calculation

Figure 3.3 explains that the calculation begins with determining the probability with and without regard to disease obtained from the calculation probability from medical record data, and then calculate each with possible symptoms of the disease according to the Bayes Theorem formula, then put the symptoms experienced by children based on medical record data according to the age criteria of the children, then calculate the total value the symptoms experienced, and the last is to obtain results in a total bayes value in the form of a belief value of the result a disease.

3.3.3 Comparison of Result by SPSS Application

The next step after getting the total value of a disease in CF and bayes method, then calculated the total value on the whole of each existing data in medical record data. Furthermore, make the comparison table of CF and Bayes method total value in accordance with the age criteria, by using SPSS 18 for windows.

3.3.4 Result of Hypothesis

The results from the comparison method can be determined by looking at the results of the analysis from SPSS. The results of the analysis are given in the form of a hypothesis. There are two hypotheses are given, there are:

H0 = there is no difference, which means CF and Bayes methods equally well in this case.

H1 = there is a difference, that means there is one is better between CF and Bayes methods, if the results of the analysis explained H1 is accepted or HO is rejected, then it will be analyzed further by using the DSS application.

3.3.5 Comparison of Result by ODM Application

Comparison of the results by using the Open Decision Maker (ODM) is performed if the result of the hypothesis H1 is accepted or H0 is rejected, but which will be compared is only the case at the age criterion H1 is accepted, instead of comparing the overall case in all age criteria.

3.3.6 Result of Alternative / Criteria Matrix

The output of ODM is alternative (method used) / criteria (cases on age criteria) that will show the value of which method is better, by looking at the alternative value at age criteria that show higher values than the other alternatives.

CHAPTER IV

ANALYSIS AND DISCUSSION

4.1 Calculation of Certainty Factor Method

Here are the steps of the calculation CF method:

4.1.1 Determine CF Value

CF values for each symptom obtained from an expert named Intan Rahmatin, Amd.FT, Spd, a therapist and owner of "Klinik Smart Tumbuh Kembang Anak" has done interviews about the certainty value of each symptom.

According to her, the value of CF on specific symptoms in the age range, there are different and same value too, it all depends on the child's age range.

Here is a table of CF value at the age of 0-1 year old:

Table 4.1 CF Value at the age of 0-1 year old

	0 – 1 year old		
	S1	S2	S3
G1	0.7	0	0
G2	0	0.7	0.7
G3	0.7	0	0.7
G4	0	0.7	0
G5	0.5	0.5	0.5
G6	0.2	0.2	0.2
G7	0.4	0.4	0.4
G8	0.5	0.5	0.5
G9	0.6	0.6	0.6
G10	0.6	0.6	0.6
G11	0.4	0.4	0.4

In accordance with medical record that at the age of 0-1 years only have 11 symptoms experienced by 10 children at that age. CF value table on the age range 1 more - 2 years, 2 more - 3 years, 3 more - 5 years are included in the appendix 3.

4.1.2 Put Symptoms

11 symptoms experienced by 10 children at the age of 0-1 year old at least one child has 5 symptoms, and most has 7 symptoms. Symptoms experienced by children with another child are different.

It can be seen in the table 4.2. Symptoms experienced at the other age criteria can be seen in the appendix 2.

Table 4.2 Symptom experienced at the age of 0-1 year old

	0-1 year old (U1)		
	S1	S2	S3
1	G1,G3, G5, G7, G11	-	-
2	G1, G3, G6, G8, G10	-	-
3	G1, G3, G9, G10, G11	-	-
4	G1, G3, G5, G7, G8	-	-
5	-	G2, G4, G5, G7, G9, G10, G11	-
6	-	G2, G4, G6, G8, G11	-
7	-	G2, G4, G5, G7, G8, G10	-
8	-	-	G2, G3, G5, G7, G10, G11
9	-	-	G2, G3, G6, G7, G8, G11
10	-	-	G2, G3, G5, G8, G9, G10

The total CF value can be calculated by summing the symptoms experienced by the child. Therefore, chosen symptoms experienced by first child at the age of 0-1 year old to be processed into the calculation.

4.1.3 Calculate Total CF Value

The process of calculate the total CF value by selecting the symptoms experienced by children and selecting CF value for each symptoms selected. It can be seen in table 4.2 as the basis of the symptoms experienced by children, and table 4.1 as CF value for each symptom.

1. First Child experienced at the age of 0-1 year old.

   CF(S1a) = CF(G1) + CF(G3) * [1-CF(G1)]

   = 0.7 + 0.7 * (1-0.7) = 0.91

   CF(S1b) = CF(G5) + CF(S1a) * [1-CF(G5)]

   = 0.5 + 0.91 * (1-0.5) = 0.955

   CF(S1c) = CF(G7) + CF(S1b) * [1-CF(G7)]

   = 0.4 + 0.95 * (1-0.4) = 0.973

   CF(S1d) = CF(G11) + CF(S1c) * [1-CF(G11)]

   = 0.4 + 0.97 * (1-0.4) = 0.9838

First Child experienced at the age of 0-1 year old who has Autistic disorder (U1S1) with total CF value is 0.9838

4.1.4 Result

After calculation on the first child, do return with the same steps for the next child until the child to the 40th.

Here are the results of the total CF value at the age of 0-1 year old on the 10 children:

Table 4.3 Result of Total CF Value at The Age of 0-1 Year Old

	0-1 year old (U1)		
	S1	S2	S3
1	0.9838	-	-
2	0.9856	-	-
3	0.99136	-	-

4	0.9865	-	-
5	-	0.997408	-
6	-	0.9784	-
7	-	0.9946	-
8	-	-	0.99352
9	-	-	0.98704
10	-	-	0.9964

In table 4.3 is explained that the first child who has Autistic disorder has a total value 0.9838, on the second child has a total value 0.9856, on the third child has a total value 0.99136, and on the fourth child has a total value 0.9865. In the fifth child who has Asperger syndrome has a total value 0.997408, on the sixth child has a total value 0.9784, and on the seventh child has a total value 0.9946. In eighth child who experienced PDD-NOS spectrum has a total value 0.99352, on the ninth child has a total value 0.98704, and on the tenth child has a total value 0.9964.

Total CF value at the age of 1 more - 2 years, 2 more - 3 years, 3 more - 5 years are included in the appendix 7.

4.2 Calculation of Bayes Theorem

Here are the steps of the calculation Bayes Theorem:

4.2.1 Determine The Probabilities

Probability value for each symptom is obtained on the medical record. Medical record on the age range can generate a probability value with and without looking at disease.

Here are symptoms probability table with looking at the disease:

Table 4.4 Symptoms Probability With Looking at Disease

	0 – 1 year old		
	S1	S2	S3

G1	0.4	0	0
G2	0	0.3	0.3
G3	0.3	0	0.3
G4	0	0.3	0
G5	0.2	0.2	0.2
G6	0.1	0.1	0.1
G7	0.2	0.2	0.2
G8	0.2	0.2	0.2
G9	0.1	0.1	0.1
G10	0.2	0.2	0.2
G11	0.2	0.2	0.2

In table 4.4 the probability value is obtained from division value on the number of one symptom from the disease in the total children at the each age criteria. For example, based on table 4.2 that the number of G1 who have Autistic disorder (S1) are 4 children with the total number of children at the age of 0-1 year old is 10 people, it can be calculated by 4/10 = 0.4, so the G1 probability value with looking at disease (S1) is 0.4. Then do the same on the other symptoms and diseases on the every age criteria.

Here are symptoms probability table without looking at disease:

Table 4.5 Symptoms Probability Without Looking at Disease

	0 – 1 year old
G1	0.4
G2	0.6
G3	0.7
G4	0.4
G5	0.6
G6	0.3
G7	0.6
G8	0.6
G9	0.3
G10	0.6
G11	0.6

In Table 4.5 the probability value is obtained from division value on the number of the symptoms from three diseases with total children at the each age criteria. For example, based on table 4.2 that the number of G1 on Autistic Disorder is 4 children, on Asperger syndrome is 0, and on spectrum PDD-NOS is 0. So the number of G1 on 3 diseases is 4 + 0 + 0 = 4 children, with the total number of children at the age of 0-1 year old is 10, it can be calculated by 4/10 = 0.4, so the G1 probability value without looking at disease is 0.4. Then do the same on other symptoms on every age criteria.

For looking at the symptoms probability table at the age 1 more – 5 years old with looking at disease in the appendix 4 and the symptoms probability table at the age 1 more – 5 years old without looking at disease, can be seen on the appendix 5.

4.2.2 Calculate The Symptoms with Possible

The whole existing symptoms at four age criteria calculated using Bayes Theorem for evidence and double hypothesis.

Here is the calculation of the value of symptoms using Bayes Theorem:

Bayes value calculation:

1. The whole symptoms experienced by the Autistic disorder at the age of 0-1 year old.

a. P(H1 | E1) = $\frac{P(E1|H1) * P\ (H1)}{P(E1|H1) * P(H1) + P(E1|H2) * P(H2) + P(E1|H3) * P(H3)}$

$$= \frac{0.4 * 0.4}{0.4 * 0.4 + 0 * 0.4 + 0 * 04}$$

$$= \frac{0.8}{0.8}$$

$$= 1$$

$$= 0.9$$

b. P(H1 | E3) = $\frac{P(E3|H1) * P\ (H1)}{P(E3|H1) * P(H1) + P(E3|H2) * P(H2) + P(E3|H3) * P(H3)}$

$$= \frac{0.3 * 0.7}{0.3 * 0.7 + 0 * 0.7 + 0.3 * 0.7}$$

$$= \frac{0.21}{0.42}$$

= 0.5

c. $P(H1 \mid E5) = \frac{P(E5|H1) * P\ (H1)}{P(E5|H1) * P(H1) + P(E5|H2) * P(H2) + P(E5|H3) * P(H3)}$

$$= \frac{0.2 * 0.6}{0.2 * 0.6 + 0.2 * 0.6 + 0.2 * 0.6}$$

$$= \frac{0.12}{0.36}$$

= 0.33

d. $P(H1 \mid E6) = \frac{P(E6|H1) * P\ (H1)}{P(E6|H1) * P(H1) + P(E6|H2) * P(H2) + P(E6|H3) * P(H3)}$

$$= \frac{0.1 * 0.3}{0.1 * 0.3 + 0.1 * 0.3 + 0.1 * 0.3}$$

$$= \frac{0.3}{0.9}$$

= 0.33

e. $P(H1 \mid E7) = \frac{P(E7|H1) * P\ (H1)}{P(E7|H1) * P(H1) + P(E7|H2) * P(H2) + P(E7|H3) * P(H3)}$

$$= \frac{0.2 * 0.6}{0.2 * 0.6 + 0.2 * 0.6 + 0.2 * 0.6}$$

$$= \frac{0.12}{0.36}$$

= 0.33

f. $P(H1 \mid E8) = \frac{P(E8|H1) * P\ (H1)}{P(E8|H1) * P(H1) + P(E8|H2) * P(H2) + P(E8|H3) * P(H3)}$

$$= \frac{0.2 * 0.6}{0.2 * 0.6 + 0.2 * 0.6 + 0.2 * 0.6}$$

$$= \frac{0.12}{0.36}$$

$= 0.33$

g. $P(H1 \mid E9) = \frac{P(E9|H1) * P\ (H1)}{P(E9|H1) * P(H1) + P(E9|H2) * P(H2) + P(E9|H3) * P(H3)}$

$$= \frac{0.1 * 0.3}{0.1 * 0.3 + 0.1 * 0.3 + 0.1 * 0.3}$$

$$= \frac{0.3}{0.9}$$

$= 0.33$

h. $P(H1 \mid E10) = \frac{P(E10|H1) * P\ (H1)}{P(E10|H1) * P(H1) + P(E10|H2) * P(H2) + P(E10|H3) * P(H3)}$

$$= \frac{0.2 * 0.6}{0.2 * 0.6 + 0.2 * 0.6 + 0.2 * 0.6}$$

$$= \frac{0.12}{0.36}$$

$= 0.33$

i. $P(H1 \mid E11) = \frac{P(E11|H1) * P\ (H1)}{P(E11|H1) * P(H1) + P(E11|H2) * P(H2) + P(E11|H3) * P(H3)}$

$$= \frac{0.2 * 0.6}{0.2 * 0.6 + 0.2 * 0.6 + 0.2 * 0.6}$$

$$= \frac{0.12}{0.36}$$

$= 0.33$

After doing all Bayes calculations on the symptoms experienced by the Autistic disorder (S1), then count back Asperger syndrome (S2), and PDD-NOS (S3) at the other four age criteria.

Here are the results of the Bayes calculation on all existing symptoms at the age of 0-1 year old:

Table 4.6 Bayes Value at The Age of 0-1 year old

	0 – 1 year old		
	S1	S2	S3
G1	0.9	0	0
G2	0	0.5	0.5
G3	0.5	0	0.5
G4	0	0.9	0
G5	0.33	0.33	0.33
G6	0.33	0.33	0.33
G7	0.33	0.33	0.33
G8	0.33	0.33	0.33
G9	0.33	0.33	0.33
G10	0.33	0.33	0.33
G11	0.33	0.33	0.33

Bayes value table on the age criteria 1 more - 2 years, 2 more - 3 years, 3 more - 5 years are included in the appendix 6.

4.2.3 Put Symptoms

Data were compared must be equal to the number of symptoms experienced and the age criteria of children. Therefore, the symptoms are similar to the symptoms that have been selected on the CF method, the symptoms experienced by the child first in the Autistic disorder at the age of 0-1 year old.

1. First Child experienced at the age of 0-1 year old.

   G1 = The child hasn't eye contact

   G3 = The child doesn't want to interact at all with other people

   G5 = The child doesn't have a social smile (smile back to others)

   G7 = When the child is doing activity, the child easily distracted and difficult to return the previous activity

G11 = Do not want to play a simple game (like “cilukba”) at the age of 7 months

4.2.4 Calculate The Total Value of The Symptoms

The process of calculating is seeing the symptoms experienced by children and the total Bayes value in each symptom selected. Table 4.2 as the basis of symptoms experienced and table 4.6 as the value of Bayes for each symptom.

1. First Child experienced at the age of 0-1 year old.

   S1a = G1 + G3 – G1*G3
   = 0.9 + 0.5 – 0.9*0.5
   = 0.95

   S1b = G5 + S1a - G5*S1a
   = 0.33 + 0.95 – 0.33*0.95
   = 0.966

   S1c = G7 + S1b - G7*S1b
   = 0.33 + 0.966 – 0.33*0.966
   = 0.977

   S1d = G11 + S1c - G11*S1c
   = 0.33 + 0.977 – 0.33*0.977
   = 0.9846

First Child experienced at the age of 0-1 year old who has Autistic disorder with total Bayes is 0.9846.

4.2.5 Result

After calculation in the first child, do return with the same steps for the next child until the child to the 40th.

Here are the results of the total Bayes value at the age of 0-1 year old in 10 children:

Table 4.7 Result of Total Bayes Value at The Age of 0-1 Year Old

	0-1 year old (U1)		
	S1	S2	S3
1	0.9846	-	-
2	0.9846	-	-
3	0.9846	-	-
4	0.9846	-	-
5	-	0.993416	-
6	-	0.985185	-
7	-	0.990123	-
8	-	-	0.950617
9	-	-	0.950617
10	-	-	0.950617

In table 4.7 is explained that the first child who has Autistic disorder has a total value 0.9846, on the second child has a total value 0.9846, on the third child has a total value 0.9846, and on the fourth child has a total value 0.9846. In the fifth child who has Asperger syndrome has a total value 0.993416, on the sixth child has a total value 0.985185, and on the seventh child has a total value 0.990123. In eighth child who experienced PDD-NOS spectrum has a total value 0.950617, on the ninth child has a total value 0.950617, and on the tenth child has a total value 0.950617.

Total Bayes value at the age of 1 more - 2 years, 2 more - 3 years, 3 more - 5 years are included in the appendix 7.

4.3 Comparison of Result by SPSS Application

Application that used in analyzing the value of the final results of the statistical data is SPSS. Data were tested in the application is the data of 10 children in each age criteria. Then at the age criteria, there are six variables, which consist of 3 variables final CF value and 3 variables final Bayes value.

Here is a comparison table of the final CF and Bayes value at the age of 0-1 year old:

Table 4.8 Comparison of The Final CF And Bayes Value at The Age of 0-1 Year Old

	U1S1_1	U1S1_2	U1S2_1	U1S2_2	U1S3_1	U1S3_2
Child 1	.98380	.98460	.0	.0	.0	.0
Child 2	.98560	.98460	.0	.0	.0	.0
Child 3	.99136	.98460	.0	.0	.0	.0
Child 4	.98650	.98460	.0	.0	.0	.0
Child 5	.0	.0	.99741	.99342	.0	.0
Child 6	.0	.0	.97840	.98519	.0	.0
Child 7	.0	.0	.99460	.99012	.0	.0
Child 8	.0	.0	.0	.0	.99352	.95062
Child 9	.0	.0	.0	.0	.98704	.95062
Child 10	.0	.0	.0	.0	.99640	.95062

Based on Table 4.8 U1S1_1 variable which means is the age of 0-1 year old that has autistic disorder (U1S1) on the value of CF (1). Variable U1S1_2 which means is the age of 0-1 year old that has autistic disorder (U1S1) on the value of Bayes (2). Variable U1S2_1 1 which means is the age of 0-1 years that has Asperger syndrome (U1S2) on the value of CF (1). Variable U1S2_2 which means is the age of 0-1 year old that has Asperger syndrome (U1S2) on the value of Bayes (2). Variable U1S3_1 1 which means is the age of 0-1 year old that has PDD_NOS (U1S3) on the value of CF (1). Variable U1S3_2 1 which means is the age of 0-1 year old that has PDD_NOS (U1S3) on the value of Bayes (2).

The table of the final CF and Bayes value at the age of 1 more-2 years old, 2 more – 3 years old, 3 more - 5 years old on the appendix 7.

1. Paired Sample T-Test

   Procedure paired sample t test was used to test two samples in pairs, whether having an average which are significantly different or not. To perform this procedure from SPSS main menu, choose **Analyze → Compare Mean → Paired-Samples T Test.** It will display a dialog box Paired Sample T-test.

All numeric variables in your data file will be displayed in the list box variable.

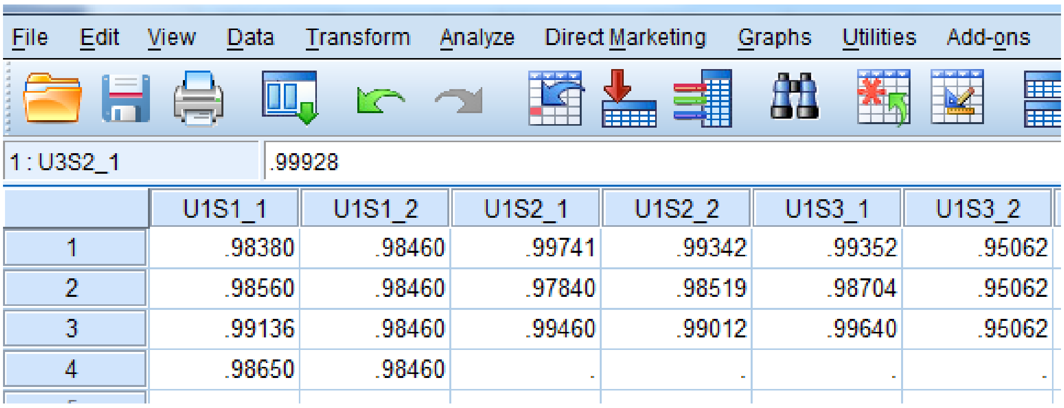
1. Move one or several pairs of variables at once to the box Paired Variables.

   To move the perform pair the following steps:

   a. Click on one of the variables, so it will be displayed as the first variable in the Current Selections box.
   b. Click the other variables, as a partner, so it will be displayed as a second variable in the Current Selections box.
2. To create a pair of variables again. Repeat steps above.
3. Click the options to determine the value of confidence of 95%.
4. Click OK to get the results of the analysis.

The data compared are the same of age criteria, disease, and the number of children. At the age of 0-1 year old (U1), Autistic disorder (S1) consists of 4 people, Asperger syndrome (S2) consists of 3 people, and PDD-NOS disease (S3) consists of 3 people. The number of data on each child's disease at the age of 0-1 year old is different therefore the comparison is done one by one.

Here is a data screenshot of U1S1_1, U1S1_2, U1S2_1, U1S2_2, U1S3_1, and U1S3_2.



	U1S1_1	U1S1_2	U1S2_1	U1S2_2	U1S3_1	U1S3_2
1	.98380	.98460	.99741	.99342	.99352	.95062
2	.98560	.98460	.97840	.98519	.98704	.95062
3	.99136	.98460	.99460	.99012	.99640	.95062
4	.98650	.98460	.	.	.	.

Figure 4.1 Screenshot Data at The Age of 0-1 year old
on SPSS Application

Data screenshot at the age of 1 more - 2 years, 2 more - 3 years, 3 more - 5 years are included in the appendix 8.

4.4 Result of Hypothesis

In the science of statistics, there are two possible hypotheses that happened. Two hypotheses are H0 and H1. In this case, are:

H0 = There is no difference, which means CF and Bayes methods equally well in this case

H1 = There is a difference, which means there is one is better between CF and Bayes methods.

The value to be analyzed is T_{count} value in the output t column on paired sample t test, to determine whether H0 is rejected or accepted, it must seek T_{table} as limitations. T_{table} value obtained from the t (a: df); with the a value is 5% and df (degrees of freedom) = N-1.

Comparisons were done on U1S1_1 variable (at the age of 0-1 year old that has Autistic disorder by using CF method) with variable U1S1_2 (at the age of 0-

1 year that has Autistic disorder by using Bayes method) with the amount is 4 people.

Here is the output from SPSS at the age of 0-1 year old that has Autistic disorder.

Table 4.9 Output U1S1 Value in CF and Bayes Methods with SPSS Application

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	U1S1_1 - U1S1_2	.00221500	.00323124	.00161562	-.00292662	.00735662	1.371	3	.264

The result of the comparison t_{count} U1S1_1 and U1S1_2 value is 1.371. Then count T_{table}, T (a: df); with the a value is 5% and df (degrees of freedom) = N-1 = 4-1 = 3, then obtained T_{table} = 3,182 because there are two sides t values range is -3182 < t_{count} < 3182.

T_{count} results can also be described in a curve, where the curve is 95% indicate the reception region and 5% rejection region. The results of the data can be said H0 is rejected if the value of t_{count} in the table is not found in the reception region, as well as if H0 is accepted is if tcount on the tables contained in the reception area.

Here is the curve of the rejection and reception region U1S1 variable picture.

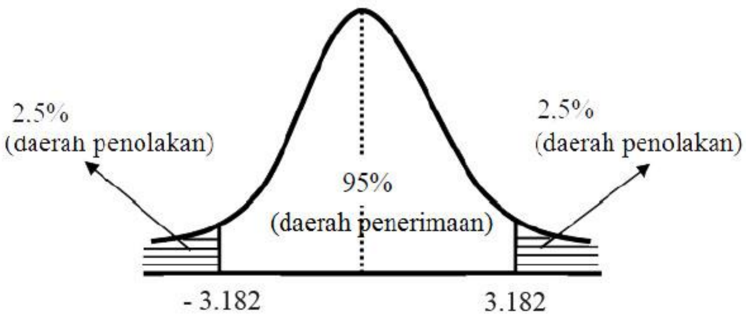


Figure 4.2 The Curve of The Rejection and Reception Region U1S1 Variable

T_{count} in Table 4.9 is 1.371, and t_{count} on the reception region curve, which means is **H0 is accepted**. Thus the result at the age of 0-1 year old that has Autistic disorder (U1S1) states that by using both CF and Bayes method the results will be as good in determining Autistic disorder.

Comparisons also were done on U1S2_1 variables (at the age of 0-1 year old that has Asperger syndrome by using CF method) with variable U1S2_2 (at the age of 0-1 year old that has Asperger syndrome by using Bayes method) with the amount is 3 people.

Here is the output from SPSS at the age of 0-1 year old in Asperger syndrome.

Table 4.10 Output U1S2 Value in CF and Bayes Methods With SPSS Application

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	U1S2_1 - U1S2_2	.00056133	.00636673	.00367583	-.01525450	.01637717	.153	2	.893

The result of the comparison t_{count} U1S2_1 and U1S2_2 value is 0.153. Then count T_{table}, T (a: df); with the a value is 5% and df (degrees of freedom) = N-1 = 3-1 = 2, then obtained T_{table} = 4.303 because there are two sides t values range is $-4.303 < t_{count} < 4.303$.

Here is the curve of the rejection and reception region U1S2 variable picture.

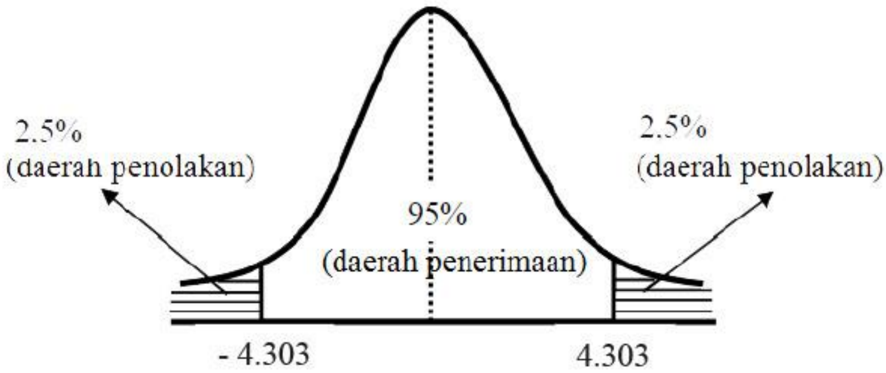


Figure 4.3 The Curve of The Rejection and Reception Region U1S2 Variable

T_{count} in Table 4.10 is 0.153 and t_{count} on the reception region curve, which means is **H0 is accepted**. Thus, the result at the age of 0-1 year old that has Asperger syndrome (U1S2) states that by using both CF and Bayes method the results will be as good in determining Asperger syndrome.

Comparisons also were done on U1S3_1 variables (at the age of 0-1 year old that has PDD-NOS by using CF method) with variable U1S3_2 (at the age of 0-1 year old that has PDD-NOS by using Bayes method) with the amount is 3 people.

Here is the output from SPSS at the age of 0-1 year old in PDD-NOS.

Table 4.11 Output U1S3 Value CF and Bayes Method with SPSS Application

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1 U1S3_1 - U1S3_2	.04170281	.00479400	.00276782	.02979387	.05361176	15.067	2	.004

The result of the comparison t_{count} U1S3_1 and U1S3_2 value is 15.067. Then count T_{table}, T (a: df); with the a value is 5% and df (degrees of freedom) = N-1 = 3-1 = 2, then obtained Ttable = 4.303 because there are two sides t values range is $-15.067 < t_{count} < 15.067$.

Here is the curve of the rejection and reception region U1S3 variable picture.

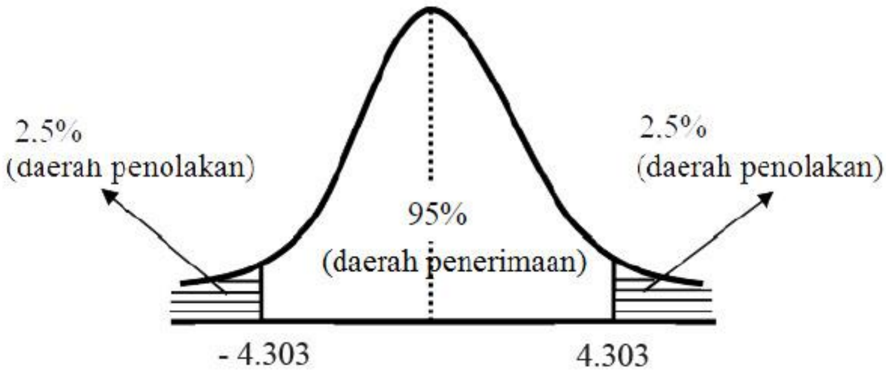


Figure 4.4 The Curve of The Rejection and Reception Region U1S3 Variable

T_{count} in Table 4.11 is 15.067 and t_{count} on the rejection region curve, which means is **H1 is accepted**. Thus, the result at the age of 0-1 year old that has PDD-NOS (U1S3) states that there is one method is better between CF and Bayes methods in determining PDD-NOS.

Here is the overall results table of the comparison of U1S1_1 with U1S1_2, U1S2_1 with U1S2_2, U1S3_1 with U1S3_2, U2S1_1 with U2S1_2, U2S2_1 with U2S2_2, U2S3_1 with U2S3_2, U3S1_1 with U3S1_2, U3S2_1 with U3S2_2, U3S3_1 with U3S3_2, U4S1_1 with U4S1_2, U4S2_1 with U4S2_2 , U4S3_1 with U4S3_2.

Table 4.12 Overall Results of The Comparison

	Pair	t_{count}	t_{table}
1	U1S1_1 with U1S1_2	1.371	$-3.182 < t_{count} < 3.182$
2	U1S2_1 with U1S2_2	0.153	$-4.303 < t_{count} < 4.303$
3	U1S3_1 with U1S3_2	15.067	$-4.303 < t_{count} < 4.303$
4	U2S1_1 with U2S1_2	17.995	$-4.303 < t_{count} < 4.303$
5	U2S2_1 with U2S2_2	0.724	$-3.182 < t_{count} < 3.182$
6	U2S3_1 with U2S3_2	0.942	$-4.303 < t_{count} < 4.303$
7	U3S1_1 with U3S1_2	0.666	$-4.303 < t_{count} < 4.303$
8	U3S2_1 with U3S2_2	45.241	$-4.303 < t_{count} < 4.303$
9	U3S3_1 with U3S3_2	4.135	$-3.182 < t_{count} < 3.182$
10	U4S1_1 with U4S1_2	1.368	$-12.71 < t_{count} < 12.71$

11	U4S2_1 with U4S2_2	-0.006	$-3.182 < t_{count} < 3.182$
12	U4S3_1 with U4S3_2	-0.033	$-3.182 < t_{count} < 3.182$

Having obtained t_{count} on each output overall comparison, then make a determination table H0 and H1 of the decision.

Table 4.13 Decision Result of HO and H1

	S1	S2	S3
U1	H0	H0	H1
U2	H1	H0	H0
U3	H0	H1	H1
U4	H0	H0	H0

Based on the table 4.13 that there are 8 decisions stating H0 is accepted and 4 decision stating H1 is accepted. In a statement H0 is accepted, are U1S1, U1S2, U2S2, U2S3, U3S1, U4S1, U4S2, and U4S3 variables that by using both CF and Bayes method the results will be as good. In a statement H1 is accepted, are U1S3, U2S1, U3S2, and U3S3 variables, that there is one method is better between CF and Bayes methods.

H1 accepted decision will be tested again using a DSS application called Open Decision Maker. The test is only performed on 4 pieces of criteria, namely U1S3, U2S1, U3S2, and U3S3. Data were tested from the average value of each criterion is multiplied by 100%.

4.5 Comparison of Result by ODM Application

The next comparison is using ODM application, to determine which method is better to use alternative and criteria in the application, after using the SPSS application that age criteria generate hypotheses H1 is accepted.

In the initial stage is to determine the alternative, alternative in this case is the method that will be compared, there are CF and Bayes. Next is to determine the criteria, the criteria in this case is the age criteria with disorder which results in hypothesis H1 is accepted. So that will be compared are some of the age criteria not the whole age criteria.

Before starting the next step, it must be calculated first each average alternative on each age criteria selected. The average score is calculated based on the final value for each child with method of CF and Bayes calculation (in the calculation of percent). It can be seen on table 4.14.

Table 4.14 Average Value of CF and Bayes

	U1S3		U2S1		U3S2		U3S3	
	CF	Bayes	CF	Bayes	CF	Bayes	CF	Bayes
1	0.9935	0.9506	0.9981	0.9943	0.9993	0.9950	0.9978	0.9758
2	0.9870	0.9506	0.9989	0.9957	0.9990	0.9950	0.9994	0.9839
3	0.9964	0.9506	0.9947	0.9915	0.9991	0.9950	0.9940	0.9456
4	-	-	-	-	-	-	0.9965	0.9637
Average	0.9923	0.9506	0.9972	0.9938	0.9991	0.9950	0.9970	0.9672
Average %	**99.23%**	**95.06%**	**99.72%**	**99.38%**	**99.91%**	**99.50%**	**99.70%**	**96.72%**

On table 4.14, the average value of the CF method at the age of 0-1 year old that has PDD-NOS (U1S3) is 99.23% and the average value of the Bayes method is 95.06%. The average value of the CF method at the age of 1 more-2 years old that has Autistic disorder (U2S1) is 99.72% and the average value of the Bayes method is 99.38%. The average value of the CF method at the age of 2 more -3 years old that has Asperger syndrome (U3S2) is 99.91% and the average value of the Bayes method is 99.50%. The average value of the CF method at the age of 2 more-3 years old that has PDD-NOS (U3S3) is 99.70% and the average value of the Bayes method is 96.72%.

The next step is to determine the deviation between the average of CF and Bayes method on each criterion. It can be seen on table 4.15.

Table 4.15 Deviation of CF and Bayes

Criteria	Average		Deviation
	CF	Bayes	
U1S3	99.23%	95.06%	4.17%
U2S1	99.72%	99.38%	0.34%
U3S2	99.91%	99.50%	0.41%
U3S3	99.70%	96.72%	2.98%

In the table 4.15, deviation value of U1S3 is 4.17%, deviation value of U2S1 is 0.34%, deviation value of U3S2 is 0.41%, and deviation value of U3S3 is 2.98%.

Then define the range deviation value to Weight. Weight is the result value scale of the criteria deviation or the alternative deviation, made by researcher, if there is no deviation between them (value of 0) then given a Weight of 1, which means that the CF and Bayes methods equally well. If the result of the deviation value is not 0 then included on a Weight of 2-9, with details such as the following table 4.16:

Table 4.16 Weight of ODM

Weight of ODM	
Range Value	Weight
0	1
0.1-1.99	2
2 - 2.99	3
3 - 3.99	4
4 - 4.99	5
5 - 5.99	6
6 - 6.99	7
7 - 7.99	8
8 - …	9

On table 4.16, the range value is made from the value of 0.1 to 1.99 is defined as Weight 2. The value of 2 to 2.99 is defined as Weight 3. The value of 3 to 3.99 is defined as Weight 4. The value of 4 to 4.99 is defined as Weight 5. The value of 5 to 5.99 is defined as Weight 6. The value of 6 to 6.99 is defined as Weight 7. The value of 7 to 7.99 is defined as Weight 8. The value of 8 to undefined is defined as Weight 9.

And then create a table weighting criteria. Weighting criteria is to determine Weight by calculating the deviation between the first criteria deviation to the next criteria deviation. Deviation in the first criteria derived from the deviation between the average alternative value of CF and Bayes, as shown on Table 4.15 and Weight on table 4.16.

Below is a table of Weighting Criteria which shows the results of deviation calculations and Weight between the two criteria are compared.

Table 4.17 Weighting Criteria

Criteria		Deviation of criteria	Weight	Criteria		Deviation of criteria	Weight
U2S1	0.34%	3.83%	4	U3S2	0.41%	0.07%	2
U1S3	4.17%			U2S1	0.34%		
U3S2	0.41%	3.76%	4	U3S3	2.98%	2.64%	3
U1S3	4.17%			U2S1	0.34%		
U3S3	2.98%	1.19%	2	U3S3	2.98%	2.57%	3
U1S3	4.17%			U3S2	0.41%		

In the table 4.17, Weight value given is 4 to U2S1 and U1S3 criteria, as in figure 4.5 value criteria U1S3 greater than the U2S1. U3S2 and U1S3 criteria give Weight value is 4. U3S3 and U1S3 criteria give Weight value is 2. U3S2 and U2S1 criteria give Weight value is 2. U3S3 and U2S1 criteria give Weight value is 3. And U3S3 and U3S2 criteria give Weight value is 3. (For other images are included in the appendix 10).

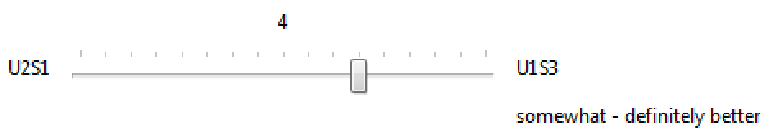


Figure 4.5 Weighting Criteria: U2S1 – U1S3

The next step is to calculate the Weighting Alternative. Weighting Alternative is to determine Weight by calculating the deviation between CF and Bayes alternative on each criterion. It can be seen table of Weighting Alternative on table 4.18.

Table 4.18 Weighting Alternative

	CF	Bayes	Deviation of CF and Bayes	Weight
U1S3	99.23%	95.06%	4.17%	5
U2S1	99.72%	99.38%	0.34%	2
U3S2	99.91%	99.50%	0.41%	2
U3S3	99.70%	96.72%	2.98%	3

In table 4.19 shows the Weight result on each criterion. In the criteria U1S3 shows Weight Value is 5, as in figure 4.6, the higher value is an alternative value of CF. In the criteria U2S1 shows Weight Value is 2. In the criteria U3S2 shows Weight Value is 2. In the criteria U3S3 shows Weight Value is 3. (For other images are included in the appendix 11).

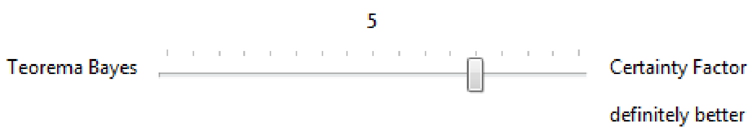


Figure 4.6 Weighting Alternative: U1S3

4.6 Result of Alternative/Criteria Matrix

ODM application will produce value for each alternative. So it can be seen which one better alternative on each criterion. And this is the result of alternative/criterion matrix on table 4.19.

Table 4.19 Alternative/Criterion Matrix

Alternative/Criteria	U1S3	U2S1	U3S2	U3S3
Certainty Factor	83.33%	66.67%	66.67%	75.00%
Bayes Theorem	16.67%	33.33%	33.33%	25.00%

Based on the table 4.19, from the four criteria that included a ODM application states that the method of certainty factor is better than Bayes theorem method at the age of 0-1 year old on PDD-NOS, at the age of 1 more - 2 years old on Autistic disorder, and at the age of 2 more - 3 years old on Asperger syndrome and PDD-NOS.

CHAPTER V

CONCLUSION REMARKS

5.1 Conclusion

Based on the description in the previous chapter, it can be concluded that:

1. The calculation results total certainty value of ASD in children under 5 years old, can be calculated using Certainty Factor and Bayes Theorem methods.
2. The Final value results of the CF and Bayes methods can be compared with the same of age criteria, symptoms inputted, and disorder outputted. The results of the comparison have diverse values at each age criteria, it is caused by a number of symptoms experienced and the method of CF and Bayes values on each symptom are different.

Here is the comparison of the CF and Bayes method in all age criteria.

Table 5.1 Comparison of the CF and Bayes Methods

Children		1	2	3	4	5	6	7	8	9	10
U1	S1 CF	0.9838	0.9856	0.9914	0.9856	-	-	-	-	-	-
	S1 BYS	0.9846	0.9846	0.9846	0.9846						-
	S2 CF					0.9974	0.9784	0.9946			-
	S2 BYS					0.9934	0.9934	0.9934		-	-
	S3 CF								0.9935	0. 9870	0.9964
	S3 BYS								0.9506	0.9506	0.9506
Children		11	12	13	14	15	16	17	18	19	20
U2	S1 CF	0.9981	0.9989	0.9947							
	S1 BYS	0.9943	0.9957	0.9914							
	S2 CF				0.9976	0.9971	0.9964	0.9909			
	S2 BYS				0.9915	0.9950	0.9963	0.9938			
	S3 CF								0.9992	0.9982	0.9983
	S3 BYS								0.9909	0.9975	0.9992
Children		21	22	23	24	25	26	27	28	29	30
U3	S1 CF	0.9983	0.9996	0.9997							
	S1 BYS	0.9992	0.9995	0.9966							
	S2 CF				0.9992	0.9989	0.9991				
	S2 BYS				0.9949	0.9949	0.9949				
	S3 CF							0.9978	0.9994	0.994	0.9965
	S3 BYS							0.9758	0.9838	0.9455	0.9637
Children		31	32	33	34	35	36	37	38	39	40
U4	S1 CF	0.9995	0.9998								
	S1 BYS	0.9990	0.9968								
	S2 CF			0.9996	0.9994	0.9997	0.9983				
	S2 BYS			0.9977	0.9996	0.9999	0.9998				
	S3 CF							0.9997	0.9961	0.9984	0.9975
	S3 BYS							0.9994	0.9990	0.9997	0.9940

3. The final value calculation Certainty Factor and Bayes Theorem methods can determine the best method between Certainty Factor and Bayes Theorem that has the best accuracy in detecting the possibility of children affected by Autism Spectrum Disorders.
   Here is the decision result of each age criterion.

Table 5.2 Decision Result of The Best Method

	Autistic Disorder	Asperger Syndrome	PDD-NOS
0 – 1 year old	CF = BAYES	CF = BAYES	CF
1 more – 2 years old	CF	CF = BAYES	CF = BAYES
2 more – 3 years old	CF = BAYES	CF	CF
3 more – 5 years old	CF = BAYES	CF = BAYES	CF = BAYES

Based on Table 5.2, shows that Certainty Factor and Bayes methods equally well in the following cases: In children at the age of 0-1 year old who have Autistic disorder and Asperger syndrome, at the age of 1 more - 2 years old who have Asperger syndrome and PDD-NOS, at the age of 2 more - 3 years old who have Autistic disorder, and at the age of 3 - 5 years old who have Autistic disorder, Asperger syndrome, and PDD-NOS. The result of this decision is based on the application of SPSS that showed H0 is accepted.

Table 5.2 also shows that Certainty Factor method is the best method, that the method produces a final value best accuracy, in the following cases: In children at the age of 0-1 year old who have PDD-NOS, at the age of 1 more - 2 years old who have Autistic disorder, at the age of 2 more - 3 years old who have Asperger syndrome and PDD-NOS. The result of this decision is based on ODM application that shows that the value of certainty factor is first ranked in the amount of 77.15%.

5.2 Suggestion

Suggestions for the next study is that researchers can use medical records are more than 40 child, so that the level of confidence in a score higher, and expected to use more than one experts for knowledge base, using multiple sources of different experts will make an analysis of results clearer disease with symptoms experienced by the patient.

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APPENDIX 1

Medical Records Data on "Klinik Smart Tumbuh Kembang Anak"

	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G16	G17	G18	G19	G20	G21	G22	G23	G24	G25	G26	G27	G28	G29	G30	G31	S1	S2	S3
1	v		v		v		v				v																					Y	N	N
2		v	v		v		v			v	v																					N	N	Y
3	v		v			v		v		v																						Y	N	N
4	v		v						v	v	v																					Y	N	N
5	v		v		v		v	v																								Y	N	N
6		v		v	v		v		v	v	v																					N	Y	N
7		v		v		v		v			v																					N	Y	N
8		v	v			v	v	v			v																					N	N	Y
9		v	v		v			v	v	v																						N	N	Y
10		v		v	v		v	v		v																						N	Y	N
11		v	v				v		v	v			v	v			v		v													N	N	Y
12		v	v		v			v				v			v	v		v														N	N	Y
13		v		v					v	v					v				v													N	Y	N
14		v	v		v		v					v	v	v		v		v														N	N	Y
15		v		v	v			v						v		v		v														N	Y	N
16	v		v		v		v	v					v				v	v														Y	N	N
17	v		v						v	v				v		v	v		v													Y	N	N
18		v		v	v		v					v					v	v														N	Y	N
19		v		v			v					v		v			v															N	Y	N
20	v		v		v		v					v			v	v																Y	N	N
21	v		v		v			v					v	v						v			v									Y	N	N
22		v	v		v					v				v						v			v									N	N	Y
23		v	v					v	v	v					v						v			v								N	N	Y
24		v	v		v			v											v													N	N	Y
25		v		v	v			v		v										v			v	v								N	Y	N
26	v		v					v		v			v		v				v		v			v								Y	N	N
27	v		v		v				v	v				v					v			v		v								Y	N	N
28		v		v				v						v	v				v			v		v								N	Y	N
29		v	v											v					v			v		v								N	N	Y
30		v		v	v				v	v				v					v		v											N	Y	N
31	v		v						v	v			v						v		v	v						v				Y	N	N
32	v		v		v										v					v			v	v	v	v	v					Y	N	N
33		v		v					v	v				v					v			v		v				v			v	N	Y	N
34		v		v	v										v					v	v						v			v		N	Y	N
35		v		v											v						v		v		v		v			v	v	N	Y	N
36		v	v		v					v					v				v		v		v					v	v			N	N	Y
37		v	v																		v			v		v			v			N	N	Y
38		v		v	v																	v								v	v	N	Y	N
39		v	v		v									v						v		v						v	v			N	N	Y
40		v	v						v						v							v			v		v					N	N	Y

APPENDIX 2

Symptoms experienced at the age of 0-1 year old

	0-1 year old (U1)		
	S1	S2	S3
1	G1,G3, G5, G7, G11	-	-
2	G1, G3, G6, G8, G10	-	-
3	G1, G3, G9, G10, G11	-	-
4	G1, G3, G5, G7, G8	-	-
5	-	G2, G4, G5, G7, G9, G10, G11	-
6	-	G2, G4, G6, G8, G11	-
7	-	G2, G4, G5, G7, G8, G10	-
8	-	-	G2, G3, G5, G7, G10, G11
9	-	-	G2, G3, G6, G7, G8, G11
10	-	-	G2, G3, G5, G8, G9, G10

Symptoms experienced at the age of 1 more – 2 years old

	1 more - 2 years old (U2)		
	S1	S2	S3
1	G1,G3, G5, G7, G8, G13, G17, G18	-	-
2	G1, G3, G9, G10, G14, G16, G17, G19	-	-
3	G1, G3, G5, G7, G12, G15, G16	-	-
4	-	G2, G4, G9, G10, G15, G19	-
5	-	G2, G4, G5, G8, G14, G16, G18	-
6	-	G2, G4, G5, G7, G12, G17, G18	-
7	-	G2, G4, G7, G12, G14, G17	-
8	-	-	G2, G3, G7,G9, G10, G13, G14, G17, G19
9	-	-	G2, G3, G5, G8, G12, G15, G16,G18
10	-	-	G2, G3, G5, G7, G12, G13, G14, G16, G18

Symptoms experienced at the age of 2 more – 3 years old

	2 more - 3 years old (U3)		
	S1	S2	S3
1	G1,G3, G5, G8, G13, G14, G20, G23	-	-
2	G1, G3, G8, G10, G13, G15, G19, G21, G24	-	-
3	G1, G3, G5, G9, G10, G14, G19, G22, G24	-	-
4	-	G2, G4, G5, G8, G10, G20, G23, G24	-
5	-	G2, G4, G8, G14,G15, G19, G22, G24	-
6	-	G2, G4, G5, G9, G10, G14, G19, G21	-
7	-	-	G2, G3, G5, G10, G14, G20, G23
8	-	-	G2, G3, G8, G9, G10, G15, G21, G24
9	-	-	G2, G3, G5, G8, G19
10	-	-	G2, G3, G14, G19, G22, G24

Symptoms experienced at the age of 3 more – 5 years old

	3 more - 5 years old (U3)		
	S1	S2	S3
1	G1,G3, G9, G10, G13, G19, G21, G22, G28	-	-
2	G1, G3, G5, G15, G20, G23, G24, G25, G26, G27	-	-
3	-	G2, G4, G9, G10, G14, G19, G22, G24, 28	-
4	-	G2, G4, G5, G15, G20, G21, G27, G30	-
5	-	G2, G4, G15, G21, G23, G25, G27, G30, G31	-
6	-	G2, G4, G5, G22, G30, G31	-

7	-	-	G2, G3, G5, G10, G15, G19, G21, G23, G28, G29
8	-	-	G2, G3, G21, G24, G26, G29
9	-	-	G2, G3, G5, G14, G20, G22, G28, G29
10	-	-	G2, G3, G9, G15, G22, G25, G27

APPENDIX 3

CF value at the age of 0-1 year old

	0-1 year old		
	S1	S2	S3
G1	0.7	0	0
G2	0	0.7	0.7
G3	0.7	0	0.7
G4	0	0.7	0
G5	0.5	0.5	0.5
G6	0.2	0.2	0.2
G7	0.4	0.4	0.4
G8	0.5	0.5	0.5
G9	0.6	0.6	0.6
G10	0.6	0.6	0.6
G11	0.4	0.4	0.4

CF value at the age of 1 more - 2 years old

	1 more – 2 years old		
	S1	S2	S3
G1	0.8	0	0
G2	0	0.8	0.8
G3	0.7	0	0.7
G4	0	0.7	0
G5	0.5	0.5	0.5
G7	0.4	0.4	0.4
G8	0.5	0.5	0.5
G9	0.6	0.6	0.6
G10	0.6	0.6	0.6
G12	0.3	0.3	0.3
G13	0.4	0.2	0.2
G14	0.4	0.4	0.4
G15	0.4	0.4	0.4
G16	0.3	0.3	0.3
G17	0.4	0.4	0.4
G18	0.6	0.6	0.6

G19	0.6	0.6	0.6

CF value at the age of 2 more - 3 years old

	2 more – 3 years old		
	S1	S2	S3
G1	0.8	0	0
G2	0	0.8	0.8
G3	0.7	0	0.7
G4	0	0.7	0
G5	0.5	0.5	0.5
G8	0.5	0.5	0.5
G9	0.6	0.6	0.6
G10	0.6	0.6	0.6
G13	0.4	0.2	0.2
G14	0.4	0.4	0.4
G15	0.4	0.4	0.4
G19	0.6	0.6	0.6
G20	0.5	0.5	0.5
G21	0.5	0.5	0.5
G22	0.4	0.4	0.4
G23	0.4	0.4	0.4
G24	0.6	0.6	0.6

CF value at the age of 3 more - 5 years old

	3 more – 5 years old		
	S1	S2	S3
G1	0.8	0	0
G2	0	0.8	0.8
G3	0.7	0	0.7
G4	0	0.7	0
G5	0.5	0.5	0.5
G9	0.6	0.6	0.6
G10	0.6	0.6	0.6
G13	0.4	0.2	0.2
G14	0.4	0.4	0.4

G15	0.4	0.4	0.4
G19	0.6	0.6	0.6
G20	0.5	0.5	0.5
G21	0.5	0.5	0.5
G22	0.4	0.4	0.4
G23	0.4	0.4	0.4
G24	0.6	0.6	0.6
G25	0.6	0.3	0.3
G26	0.5	0	0.2
G27	0.6	0.6	0.6
G28	0.3	0.3	0.3
G29	0	0	0.6
G30	0	0.7	0
G31	0	0.7	0

APPENDIX 4

Symptoms Probability Table With Looking at Disease (U1)

	0-1 year old		
	S1	S2	S3
G1	0.4	0	0
G2	0	0.3	0.3
G3	0.3	0	0.3
G4	0	0.3	0
G5	0.2	0.2	0.2
G6	0.1	0.1	0.1
G7	0.2	0.2	0.2
G8	0.2	0.2	0.2
G9	0.1	0.1	0.1
G10	0.2	0.2	0.2
G11	0.2	0.2	0.2

Symptoms Probability Table With Looking at Disease (U2)

	1 more – 2 years old		
	S1	S2	S3
G1	0.3	0	0
G2	0	0.4	0.3
G3	0.3	0	0.3
G4	0	0.4	0
G5	0.1	0.2	0.2
G7	0.2	0.2	0.2
G8	0.1	0.1	0.1
G9	0.1	0.1	0.1
G10	0.1	0.1	0.1
G12	0.1	0.2	0.2
G13	0.1	0	0.2
G14	0.1	0.2	0.2
G15	0.1	0.1	0.1
G16	0.2	0.1	0.2
G17	0.2	0.2	0.1
G18	0.1	0.2	0.2

G19	0.1	0.1	0.1

Symptoms Probability Table With Looking at Disease (U3)

	2 more – 3 years old		
	S1	S2	S3
G1	0.3	0	0
G2	0	0.3	0.4
G3	0.3	0	0.4
G4	0	0.3	0
G5	0.2	0.2	0.2
G8	0.2	0.2	0.2
G9	0.1	0.1	0.1
G10	0.2	0.2	0.2
G13	0.2	0	0
G14	0.2	0.2	0.2
G15	0.1	0.1	0.1
G19	0.2	0.2	0.2
G20	0.1	0.1	0.1
G21	0.1	0.1	0.1
G22	0.1	0.1	0.1
G23	0.1	0.1	0.1
G24	0.2	0.2	0.2

Symptoms Probability Table With Looking at Disease (U4)

	3 more – 5 years old		
	S1	S2	S3
G1	0.2	0	0
G2	0	0.4	0.4
G3	0.2	0	0.4
G4	0	0.4	0
G5	0.1	0.2	0.2
G9	0.1	0.1	0.1
G10	0.1	0.1	0.1
G13	0.1	0	0
G14	0	0.1	0.1
G15	0.1	0.2	0.2
G19	0.1	0.1	0.1

G20	0.1	0.1	0.1
G21	0.1	0.2	0.2
G22	0.1	0.2	0.2
G23	0.1	0.1	0.1
G24	0.1	0.1	0.1
G25	0.1	0.1	0.1
G26	0.1	0	0.1
G27	0.1	0.2	0.1
G28	0.1	0.1	0.2
G29	0	0	0.3
G30	0	0.3	0
G31	0	0.3	0

APPENDIX 5

Symptoms Probability Table Without Looking at Disease U1

	0 – 1 year old
G1	0.4
G2	0.6
G3	0.7
G4	0.4
G5	0.6
G6	0.3
G7	0.6
G8	0.6
G9	0.3
G10	0.6
G11	0.6

Symptoms Probability Table Without Looking at Disease U2

	1 more – 2 years old
G1	0.3
G2	0.7
G3	0.6
G4	0.4
G5	0.5
G7	0.6
G8	0.3
G9	0.3
G10	0.3
G12	0.5
G13	0.3
G14	0.5
G15	0.3
G16	0.5
G17	0.5
G18	0.5
G19	0.3

Symptoms Probability Table Without Looking at Disease U3

	2 more – 3 years old
G1	0.3
G2	0.7
G3	0.7
G4	0.3
G5	0.6
G8	0.6
G9	0.3
G10	0.6
G13	0.2
G14	0.6
G15	0.3
G19	0.6
G20	0.3
G21	0.3
G22	0.3
G23	0.3
G24	0.6

Symptoms Probability Table Without Looking at Disease U4

	3 more – 5 years old
G1	0.2
G2	0.8
G3	0.6
G4	0.4
G5	0.5
G9	0.3
G10	0.3
G13	0.1
G14	0.2
G15	0.5
G19	0.3
G20	0.3
G21	0.5
G22	0.5
G23	0.3

G24	0.3
G25	0.3
G26	0.2
G27	0.4
G28	0.4
G29	0.3
G30	0.3
G31	0.3

APPENDIX 6

Bayes Value U1

	0 – 1 year old		
	S1	S2	S3
G1	0.9	0	0
G2	0	0.5	0.5
G3	0.5	0	0.5
G4	0	0.9	0
G5	0.33	0.33	0.33
G6	0.33	0.33	0.33
G7	0.33	0.33	0.33
G8	0.33	0.33	0.33
G9	0.33	0.33	0.33
G10	0.33	0.33	0.33
G11	0.33	0.33	0.33

Bayes value U2

	1 more – 2 years old		
	S1	S2	S3
G1	0.9	0	0
G2	0	0.57	0.43
G3	0.50	0	0
G4	0	0.9	0
G5	0.20	0.40	0.40
G7	0.33	0.33	0.33
G8	0.33	0.33	0.33
G9	0.33	0.33	0.33
G10	0.33	0.33	0.33
G12	0.20	0.40	0.40
G13	0.33	0.00	0.67
G14	0.20	0.40	0.40
G15	0.33	0.33	0.33
G16	0.40	0.20	0.40
G17	0.40	0.40	0.20
G18	0.20	0.40	0.40
G19	0.33	0.33	0.33

Bayes Value U3

	2 more – 3 years old		
	S1	S2	S3
G1	0.9	0	0
G2	0	0.43	0.57
G3	0.43	0	0.57
G4	0	0.9	0
G5	0.33	0.33	0.33
G8	0.33	0.33	0.33
G9	0.33	0.33	0.33
G10	0.33	0.33	0.33
G13	0.9	0	0
G14	0.33	0.33	0.33
G15	0.33	0.33	0.33
G19	0.33	0.33	0.33
G20	0.33	0.33	0.33
G21	0.33	0.33	0.33
G22	0.33	0.33	0.33
G23	0.33	0.33	0.33
G24	0.33	0.33	0.33

Bayes Value U4

	3 more – 5 years old		
	S1	S2	S3
G1	0.9	0	0
G2	0	0.50	0.50
G3	0.33	0.00	0.67
G4	0	0.9	0
G5	0.20	0.40	0.40
G9	0.33	0.33	0.33
G10	0.33	0.33	0.33
G13	0.9	0	0
G14	0	0.50	0.50
G15	0.20	0.40	0.40
G19	0.33	0.33	0.33
G20	0.33	0.33	0.33
G21	0.20	0.40	0.40

G22	0.20	0.40	0.40
G23	0.33	0.33	0.33
G24	0.33	0.33	0.33
G25	0.33	0.33	0.33
G26	0.50	0.00	0.50
G27	0.25	0.50	0.25
G28	0.25	0.25	0.50
G29	0	0	0.9
G30	0	0.9	0
G31	0	0.9	0

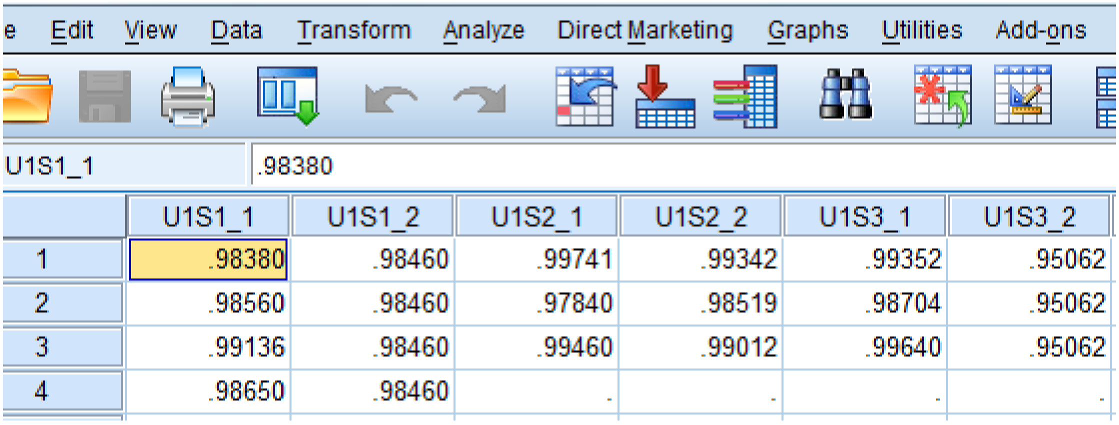
APPENDIX 7

Result of Total CF and Bayes Value at the each age criterion of 40 children.

Children		1	2	3	4	5	6	7	8	9	10
U1	S1 CF	0.9838	0.9856	0.9914	0.9856	-	-	-	-	-	-
	S1 BYS	0.9846	0.9846	0.9846	0.9846						-
	S2 CF					0.9974	0.9784	0.9946			-
	S2 BYS					0.9934	0.9934	0.9934		-	-
	S3 CF								0.9935	0. 9870	0.9964
	S3 BYS								0.9506	0.9506	0.9506
Children		11	12	13	14	15	16	17	18	19	20
U2	S1 CF	0.9981	0.9989	0.9947							
	S1 BYS	0.9943	0.9957	0.9914							
	S2 CF				0.9976	0.9971	0.9964	0.9909			
	S2 BYS				0.9915	0.9950	0.9963	0.9938			
	S3 CF								0.9992	0.9982	0.9983
	S3 BYS								0.9909	0.9975	0.9992
Children		21	22	23	24	25	26	27	28	29	30
U3	S1 CF	0.9983	0.9996	0.9997							
	S1 BYS	0.9992	0.9995	0.9966							
	S2 CF				0.9992	0.9989	0.9991				
	S2 BYS				0.9949	0.9949	0.9949				
	S3 CF							0.9978	0.9994	0.994	0.9965
	S3 BYS							0.9758	0.9838	0.9455	0.9637
Children		31	32	33	34	35	36	37	38	39	40
U4	S1 CF	0.9995	0.9998								
	S1 BYS	0.9990	0.9968								
	S2 CF			0.9996	0.9994	0.9997	0.9983				
	S2 BYS			0.9977	0.9996	0.9999	0.9998				
	S3 CF							0.9997	0.9961	0.9984	0.9975
	S3 BYS							0.9994	0.9990	0.9997	0.9940

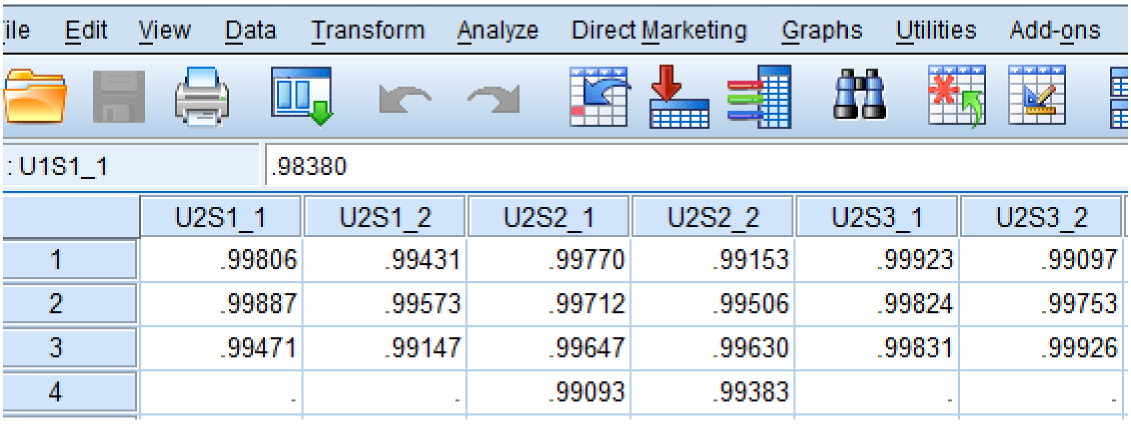
APPENDIX 8

Screenshot SPSS U1



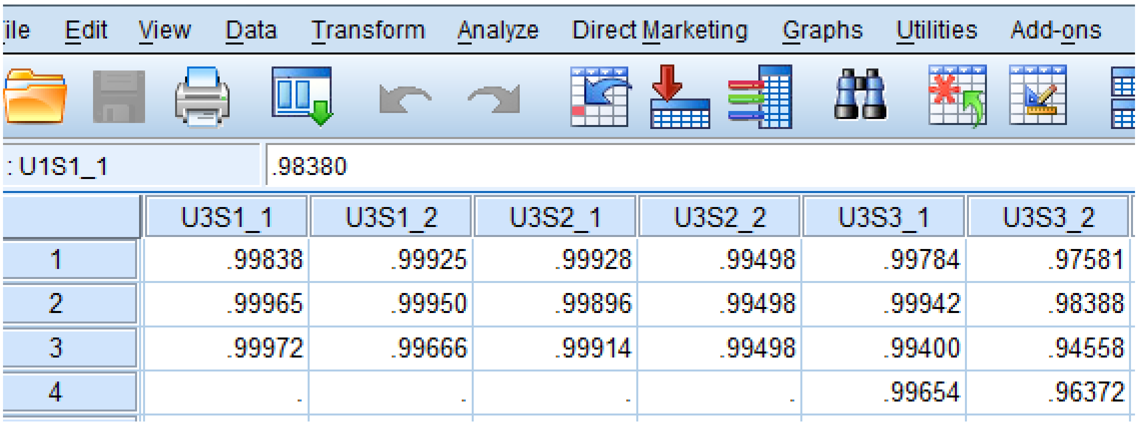
	U1S1_1	U1S1_2	U1S2_1	U1S2_2	U1S3_1	U1S3_2
1	.98380	.98460	.99741	.99342	.99352	.95062
2	.98560	.98460	.97840	.98519	.98704	.95062
3	.99136	.98460	.99460	.99012	.99640	.95062
4	.98650	.98460	.	.	.	.

Screenshot SPSS U2



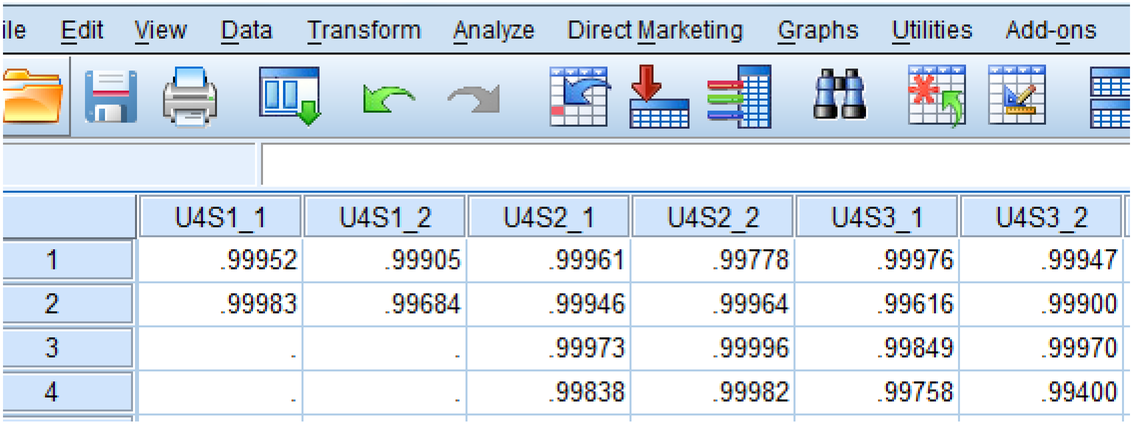
	U2S1_1	U2S1_2	U2S2_1	U2S2_2	U2S3_1	U2S3_2
1	.99806	.99431	.99770	.99153	.99923	.99097
2	.99887	.99573	.99712	.99506	.99824	.99753
3	.99471	.99147	.99647	.99630	.99831	.99926
4	.	.	.99093	.99383	.	.

Screenshot SPSS U3



	U3S1_1	U3S1_2	U3S2_1	U3S2_2	U3S3_1	U3S3_2
1	.99838	.99925	.99928	.99498	.99784	.97581
2	.99965	.99950	.99896	.99498	.99942	.98388
3	.99972	.99666	.99914	.99498	.99400	.94558
4	.	.	.	.	.99654	.96372

Screenshot SPSS U4



	U4S1_1	U4S1_2	U4S2_1	U4S2_2	U4S3_1	U4S3_2
1	.99952	.99905	.99961	.99778	.99976	.99947
2	.99983	.99684	.99946	.99964	.99616	.99900
3	.	.	.99973	.99996	.99849	.99970
4	.	.	.99838	.99982	.99758	.99400

APPENDIX 9

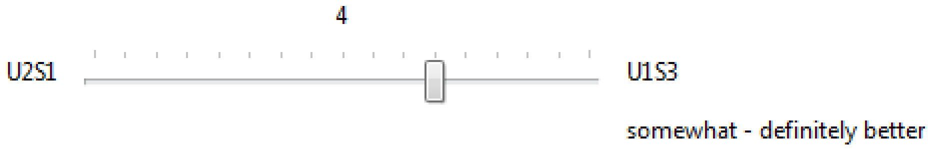
Output SPSS Paired Sample T Test

Paired Samples Test

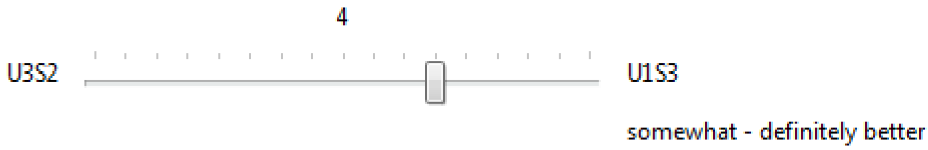
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	95% Confidence Interval of the Difference Upper			
Pair 1	U1S1_1 - U1S1_2	.00221500	.00323124	.00161562	-.00292662	.00735662	1.371	3	.264
Pair 2	U1S2_1 - U1S2_2	.00056133	.00636673	.00367583	-.01525450	.01637717	.153	2	.893
Pair 3	U1S3_1 - U1S3_2	.04170281	.00479400	.00276782	.02979387	.05361176	15.067	2	.004
Pair 4	U2S1_1 - U2S1_2	.00337467	.00032483	.00018754	.00256775	.00418158	17.995	2	.003
Pair 5	U2S2_1 - U2S2_2	.00137300	.00379065	.00189532	-.00465877	.00740477	.724	3	.521
Pair 6	U2S3_1 - U2S3_2	.00266967	.00490833	.00283383	-.00952331	.01486265	.942	2	.446
Pair 7	U3S1_1 - U3S1_2	.00078571	.00204197	.00117893	-.00428684	.00585825	.666	2	.574
Pair 8	U3S2_1 - U3S2_2	.00414667	.00016042	.00009262	.00374817	.00454516	44.773	2	.000
Pair 9	U3S3_1 - U3S3_2	.02970575	.01436900	.00718450	.00684146	.05257004	4.135	3	.026
Pair 10	U4S1_1 - U4S1_2	.00172600	.00178474	.00126200	-.01430923	.01776123	1.368	1	.402
Pair 11	U4S2_1 - U4S2_2	-.00000425	.00135732	.00067866	-.00216405	.00215555	-.006	3	.995
Pair 12	U4S3_1 - U4S3_2	-.00004500	.00273464	.00136732	-.00439641	.00430641	-.033	3	.976

APPENDIX 10

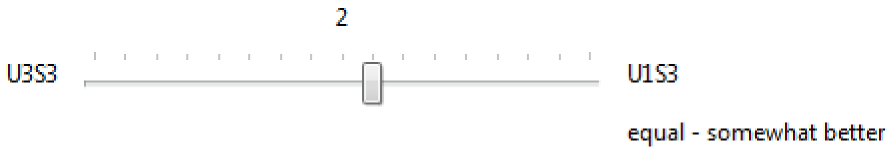
Weighting Criteria: U2S1 – U1S3



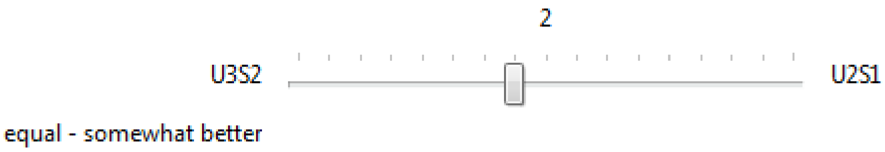
Weighting Criteria: U3S2 – U1S3



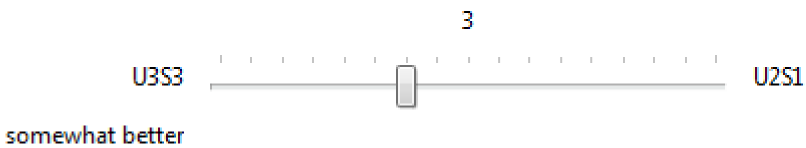
Weighting Criteria: U3S3 – U1S3



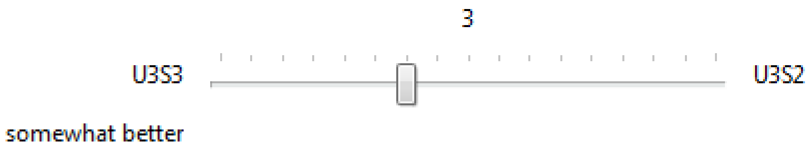
Weighting Criteria: U3S2 – U2S1



Weighting Criteria: U3S3 – U2S1

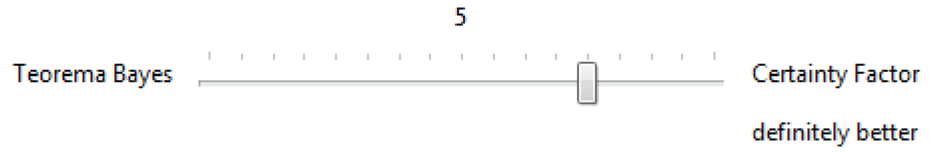


Weighting Criteria: U3S3 – U3S2

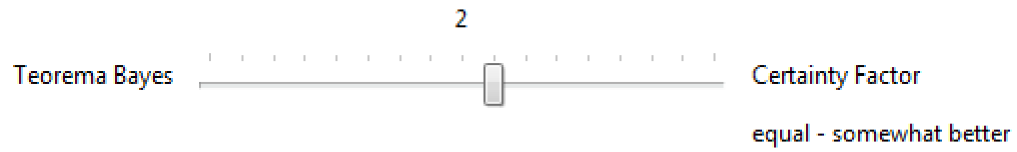


APPENDIX 11

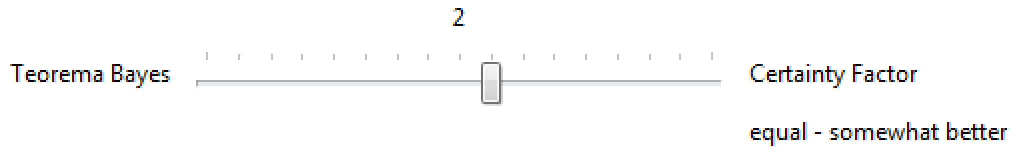
Weighting Alternative: U1S3



Weighting Alternative: U2S1



Weighting Alternative: U3S2



Weighting Alternative: U3S3